Smartek Giganetix Camera Family

GigE Vision™ digital camera

User Manual

Document version 1.2, last changed: 13. Jun. 2011

GIGE VISION

GEN<i>CAM

Smartek

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1. Overview

1.1. Precautions

Due to the ultra small compact housing of the camera, it has a tendency to develop high temperature. To maintain optimal working temperature mount the camera on a metal surface.

Do not attempt to disassemble this camera, there are sensitive optical parts inside. Tampering with it could lead to permanent damage.

Do not expose this camera to rain or moisture. This device is not intended to work under water.

Do not face this camera towards the sun, extremely bright light or light reflecting objects. Even when this camera is not in use, put the supplied lens cap on the lens mount.

Handle this camera with the maximum care. Do not throw the device, there are fragile glass parts inside.

Operate this camera only from the type of power source indicated on the camera. Operating the camera exceeding specifications can damage the camera permanently (see *2.1 Mechanical and electrical specifications*).

1.2. Description

Innovative Gigabit Ethernet technology digital camera line up specially designed to meet demanding high quality image machine vision applications conforming to industrial GigE Vision standard. Compact housing that fits almost every space critical application. Fine selection of Sony, Aptina and Kodak CCD and CMOS sensors delivers images with high sensitivity and low noise. Excellent price to performance ratio makes this portfolio perfect choice for every demanding user.

The Smartek Giganetix camera family are an affordable, easy to use digital cameras designed for industrial imaging applications. Smartek cameras combine standard Gigabit Ethernet technology with Smartek *GigEVisionSDK* image acquisition software which reliably captures and transfers images from the camera to the PC. All Smartek Giganetix cameras are supported by Smartek *GigEVisionSDK* library, and also all Smartek Giganetix cameras can perform on other software platforms. If you are using this device with other software please check the user guides from those manufacturers.

1.3. Key benefits and features

Ultra small compact form	Precise image sensor alignment
Sony; Aptina and Kodak CCD and CMOS	Optional built-in IR filter
Long cable length up to 100m	Standard C-Mount lens adapter
Uses low cost Cat5E or Cat6 Ethernet cables	Industrial connectors: EIAJ (Hirose) – 12 pin and screw mount RJ45
ADC 14bit pixel depth	Rubber sealed image sensor space
Max. 65MHz pixel clock sampling	Horizontal and vertical binning
Image exposure from 10µs to 10s	Opto–isolated inputs and outputs
Very small trigger latency ~2µs, jitter < 0.5µs	Very competitive price and performance
Partial scan and region of interest functions	Firmware update over Ethernet
High frame rates or high sensitivity option	High shock and vibration resistance
One housing size fits all sensors	Low power consumption, low thermal generation
Anodized aluminum housing	Internal image buffer for retransmission and reliability

1.4. Supported industry standards

1.4.1. GigE Vision

GigE Vision is a communication interface standard for high-performance industrial cameras based on the Gigabit Ethernet technology. The standard is trying to unify protocols currently used in *machine vision* industrial applications. GigE Vision is administered by the Automated Imaging Association (AIA).

Features of the GigE Vision standard:

- Fast data transfer rates – up to 1 Gbit/s (based on 1000BASE-T);
- Data transfer length up to 100m exceeding maximum length of FireWire, USB and Camera Link interfaces.
- Based on established standard allowing communication with other Ethernet devices and computers.

GigE Vision has four main elements:

- GigE Vision Control Protocol – runs on the UDP protocol. The standard defines how application controls and configures devices, and instantiates stream channels on the device. It also defines the way for the device to notify an application about specific events.
- GigE Vision Stream Protocol – covers the definition of data types and the ways images and other data are transferred from device to application.
- GigE Device Discovery Mechanism – provides mechanisms for a device to obtain valid IP address and for an application to enumerate devices on the network.
- An XML description file based on the GenICam standard – this file provides the mapping between a device feature and the device register implementing the feature.

1.4.2. GenICam

GenICam (Generic Interface for Cameras) is a generic programming interface for *machine vision* cameras. The goal of the standard is to decouple industrial camera interfaces technology (such as GigE Vision, Camera Link, USB or FireWire) from the user application programming interface (API). GenICam is administered by the European Machine Vision Association (EMVA).

GenICam consists of three modules to help solving the main tasks in machine vision field in a generic way. These modules are:

1. GenApi – configures the camera and details how to access and control cameras by using an XML description file.
2. Standard Feature Naming Convention (SFNC) – are the recommended names and types for common features in cameras to promote interoperability.
3. GenTL – is the transport layer interface for enumerating cameras, grabbing images from the camera, and moving them to the user application.

GenICam provides supports for five basic functions:

1. Configuring the camera – supports a range of camera features such as frame size, acquisition speed, pixel format, gain, image offset, etc.
2. Grabbing images – creates access channels between the camera and the user interface and initiates receiving images.
3. Graphical user interface – enables user GUI interface to seamlessly talk to the camera(s).
4. Transmitting extra data – enables cameras to send extra data on top of the image data. Typical examples could be histogram information, time stamp, area of interest in the frame, etc.
5. Delivering events – enables cameras to talk to the application through an event channel.

1.4.3. Standard Features Naming Convention (SFNC)

SFNC provides the definitions of standard use cases and standard features. The goal is to cover and to standardize the naming convention used in all those basic use cases where the implementation by different vendors would be very similar anyway. The GenICam technology allows exposing arbitrary features of a camera through a unified API and GUI. Each feature can be defined in an abstract manner by its name, interface type, unit of measurement and behavior. The GenApi module of the GenICam standard defines how to write a camera description file that describes a specific camera's mapping.

Smartek implemented this naming convention in all of its products. For detail information about this convention visit www.emva.org.

1.4.4. C-mount

A C-mount is a type of lens mount commonly found on 16mm movie cameras, closed-circuit television cameras, and trinocular microscope phototubes. C-mount lenses provide a male thread which mates with a female thread on the camera. The thread is nominally 1inch [25mm] in diameter, with 32 threads per inch, designated as "1-32 UN 2A" in the ANSI B1.1 standard for unified screw threads. The flange focal distance is 17.526mm [0.6900inch] for a C-mount.

1.5. Connections

1.5.1. Connecting scheme

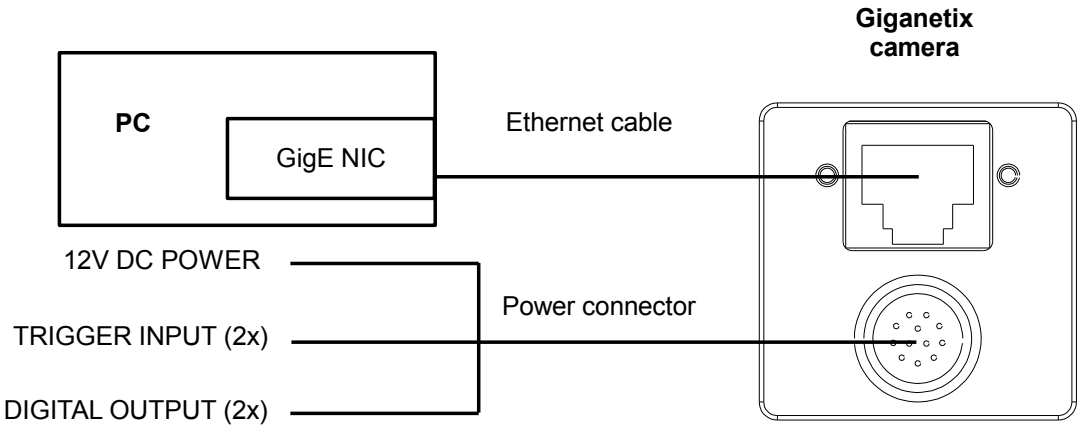


Figure 1: Connecting scheme

1.5.2. Ethernet connector

Ethernet connector	RJ45, Ethernet 1000BaseT, 803.2 compliant	
Pin no.	**Signal**	**Description**
1	BI_DA+	Bi-directional pair +A
2	BI_DA-	Bi-directional pair -A
3	BI_DB+	Bi-directional pair +B
4	BI_DC+	Bi-directional pair +C
5	BI_DC-	Bi-directional pair -C
6	BI_DB-	Bi-directional pair -B
7	BI_DD+	Bi-directional pair +D
8	BI_DD-	Bi-directional pair -D

Table 1: Ethernet connector assignment

1.5.3. Ethernet status

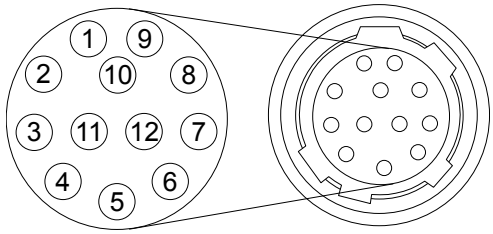
Ethernet connector comes with yellow and green LED. Green LED indicates Ethernet link and activity, while yellow LED indicates camera status.

Green LED	**Status**
Off	No link
Solid on	Link on / Ethernet link exist
Blinking	Indicates ongoing Ethernet activity

Yellow LED	**Status**
Off	Not powered
Solid on	Power on / Status OK
One blink, then Off	No user firmware / Factory firmware active
Two blinks, then Off	Watchdog timer timeout error
Three blinks, then Off	User firmware data CRC error
Four blinks, then Off	Internal FPGA configuration error

Table 2: Ethernet LEDs status

1.5.4. Power connector

Power connector	

Pin no.	**Signal**
1	Power GND
2	DC power supply
3	Output 1 -
4	Output 1 +
5	Input 2 -
6	Input 2 +
7	Input 1 +
8	Input 1 -
9	Output 2 -
10	Output 2 +
11	Input 1 +
12	Input 1 -

Table 3: Power connector assignment

1.5.5. Trigger input (all models)

Cameras are equipped with two physical input lines designated as input line 1 and input line 2. The input lines are accessed via the 12-pin receptacle on the back of the camera. Each input line is opto-isolated.

Recommended operating voltage	+0 to +24 VDC
Voltage level representing logical 0	+0 to +1.4 VDC
Region where the transition threshold occurs; the logical state is not defined in this region	> +1.4 to +2.2 VDC
Voltage level representing logical 1	> +2.2 VDC
Absolute maximum; the camera may be damaged when the absolute maximum is exceeded	+30.0 VDC

Table 4: Electrical specification for trigger input

1.5.5.1. Scheme (all models)

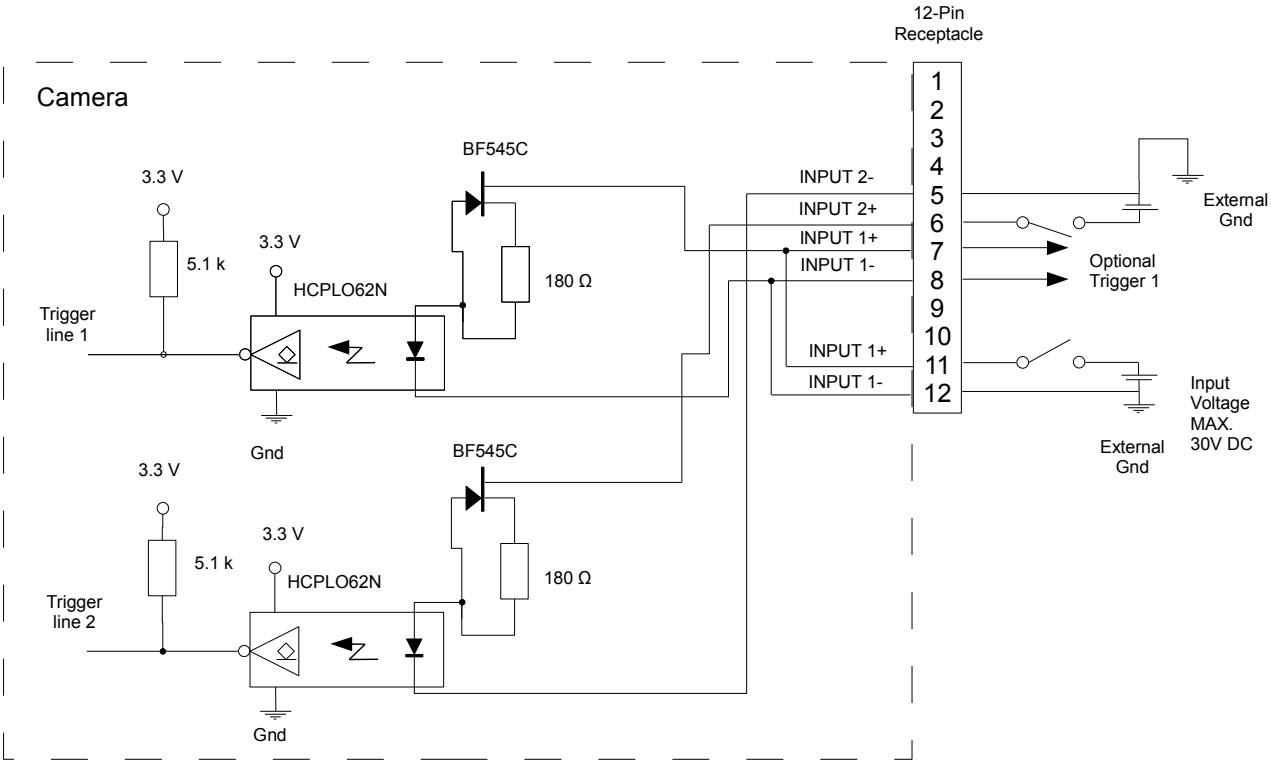


Figure 2: Trigger input scheme

1.5.6. Digital output (all models)

Cameras are equipped with two physical output lines. The output lines are accessed via the 12-pin receptacle on the back of the camera.

The I/O output may operate erratically	< +3.3 VDC
Recommended operating voltage	+3.3 to +24 VDC
Absolute maximum; the camera may be damaged if the absolute maximum is exceeded	+30.0 VDC
The maximum current surge for outputs	25 mA

Table 5: Electrical specification for digital output

1.5.7. Scheme (all models)

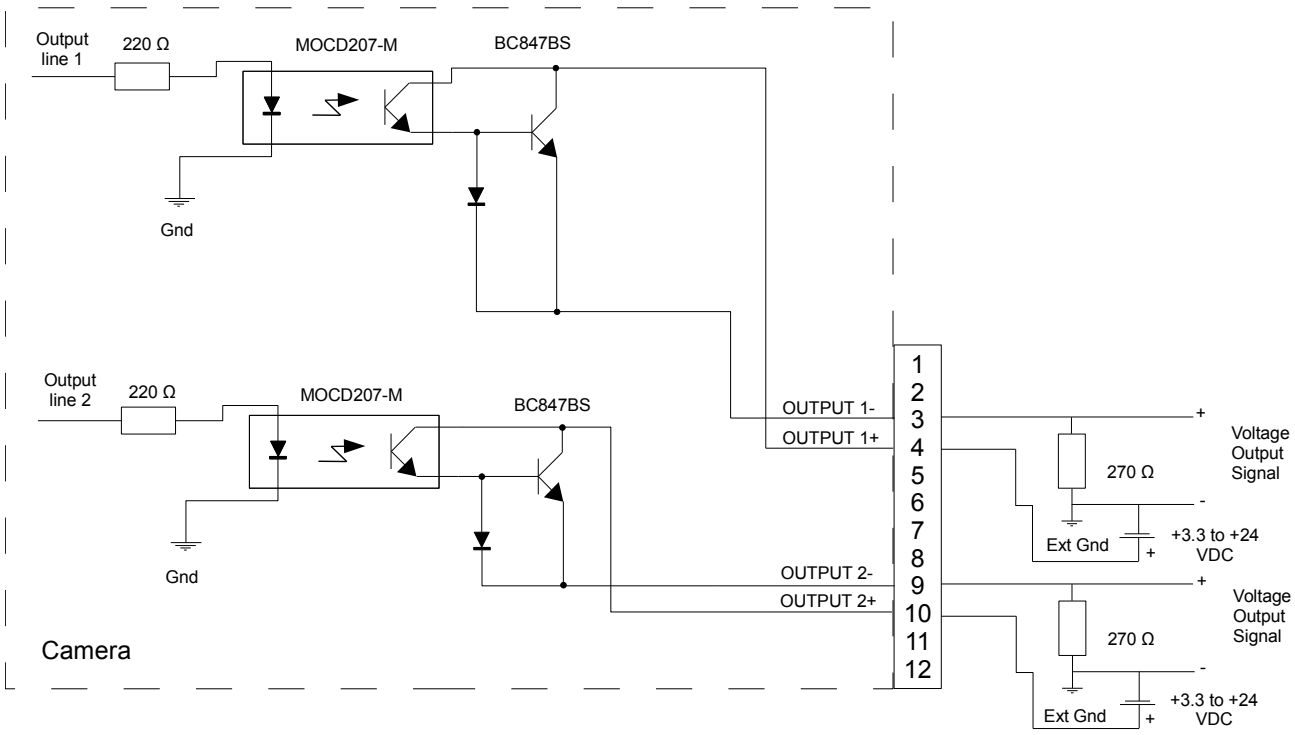


Figure 3: Digital output scheme

1.6. Mechanical and electrical specifications

External dimensions (H x W x L)	35.0 x 35.0 x 47.9 [mm] (1.38 x 1.38 x 1.89 [in])
Housing	Black anodized aluminum case
Weight	Approx. 90g (3.2oz)
Storage temperature	-30°C .. +60°C (-22°F .. +140°F)
Operating temperature	-5°C .. +45°C (+23°F .. +113°F)
Operating humidity	25% .. 80% (no condensation)
Storage humidity	25% .. 95% (no condensation)
Power requirements	+12V DC (Min 10V, Max 24V) (For optimal performance 12V DC is recommended)
Lens mount	C-mount
Connectors	Screw mount Ethernet RJ45, EIAJ (Hirose) 12 pin
Conformity	CE, FCC, RoHS, GigE Vision, GenICam

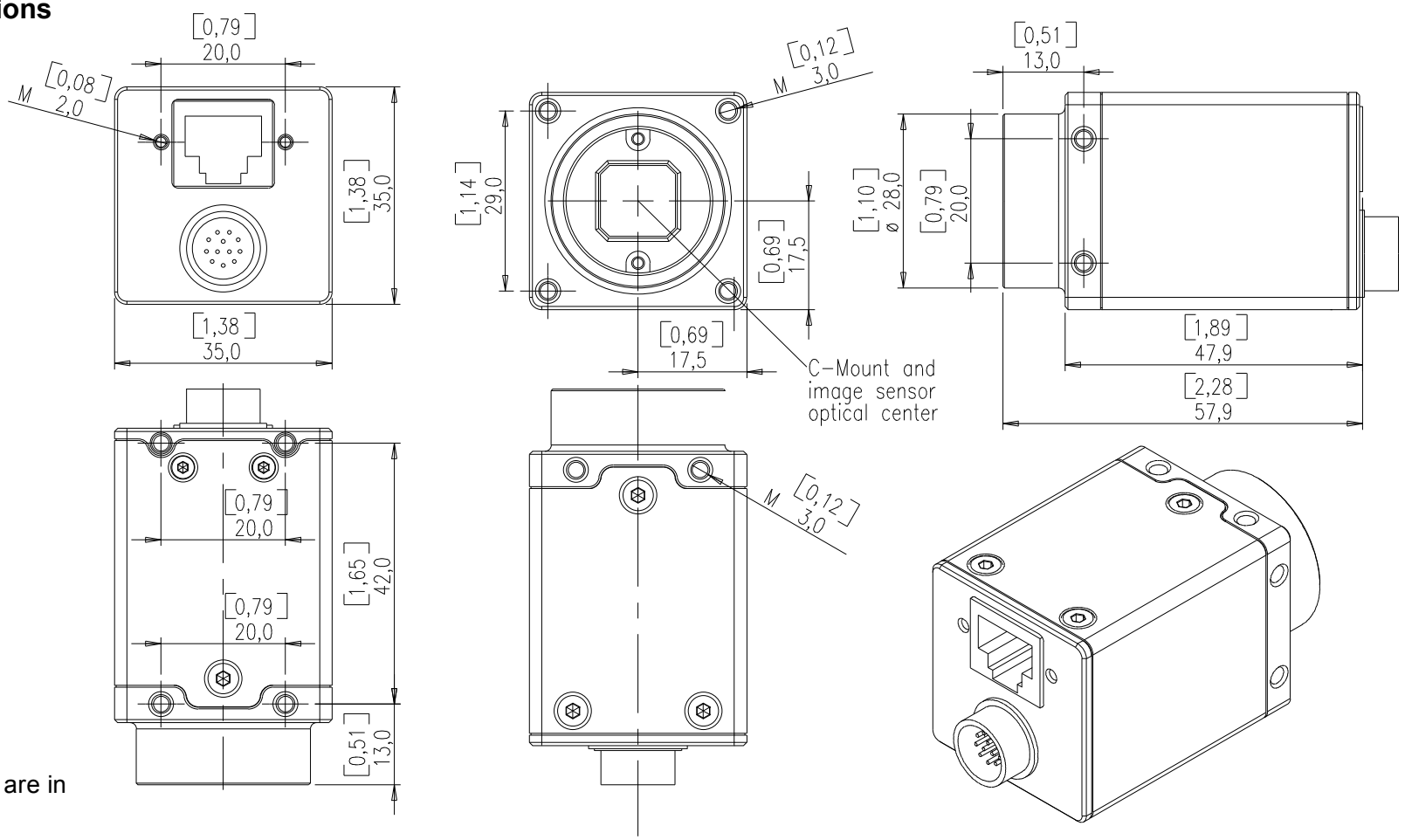
Table 6: Mechanical and electrical specifications

1.7. Software specifications

Firmware update	Over Gigabit Ethernet
Software driver	Giganetix IP filter driver; GigE Vision compliant
Client software	GigE Vision compliant GenICam compliant Windows XP, Vista, Windows 7, 32 and 64bit Linux 32 and 64bit

Table 7: Software specifications

1.8. Dimensions



All dimensions are in mm [inch].

2. Camera models

2.1. EMI and ESD consideration

Excessive EMI and ESD can cause problems with your camera such as false triggering or can cause the camera to suddenly stop capturing images. EMI and ESD can also have a negative impact on the quality of the image data transmitted by the camera.

To avoid problems with EMI and ESD, you should follow these general guidelines:

- Use high quality shielded cables. The use of high quality cables is one of the best defenses against EMI and ESD.
- Try to use camera cables that are the correct length and try to run the camera cables and power cables parallel to each other. Avoid coiling camera cables.
- Avoid placing camera cables parallel to wires carrying high-current, switching voltages such as wires supplying stepper motors or electrical devices that employ switching technology.
- Attempt to connect all grounds to a single point, e.g. use a single power outlet for the entire system and connect all grounds to the single outlet.
- Use a line filter on the main power supply.
- Install the camera and camera cables as far as possible from devices generating sparks.
- Decrease the risk of electrostatic discharge by taking the following measures:
    - Use conductive materials at the point of installation.
    - Use suitable clothing (cotton) and shoes.
- Control the humidity in your environment. Low humidity can cause ESD problems.

2.2. Sensor information and technical specification (all models separate)

Spectral sensitivity is defined without glass between CCD and lens, and without light source characteristics.

2.2.1. GC1281M

Image sensor	Aptina MT9M001
Sensor type	CMOS
Sensor resolution (H x W)	1280 x 1024
Optical size	1/2"
Pixel size (in µm)	5.2 x 5.2
Analog gain (in dB)	0 ÷ 23.5
Shutter	Rolling
Exposure Time	32µs ÷ 0.5s
Max. frame rate (at full resolution)	30
ADC bit depth	8 bits
Power consumption	2.3W
Weight	90g

Spectral Sensitivity

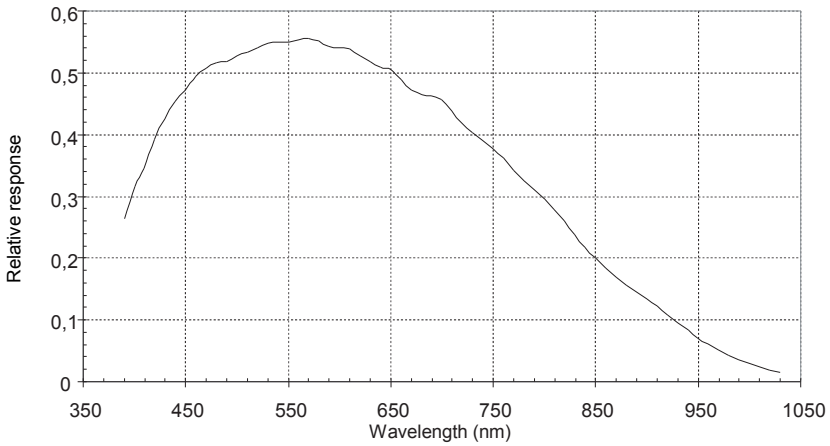


Figure 4: Spectral sensitivity for GC1281 Monochrome

2.2.2. GC2041C

Image sensor	Aptina MT9T031
Sensor type	CMOS
Sensor resolution (H x W)	2048 x 1536
Optical size	1/2"
Pixel size (in µm)	3.2 x 3.2
Analog gain (in dB)	0 ÷ 23.5
Shutter	Rolling
Exposure Time	53µs ÷ 10s
Max. frame rate (at full resolution)	12
ADC bit depth	8 bits
Power consumption	2.2W
Weight	90g

Spectral Sensitivity

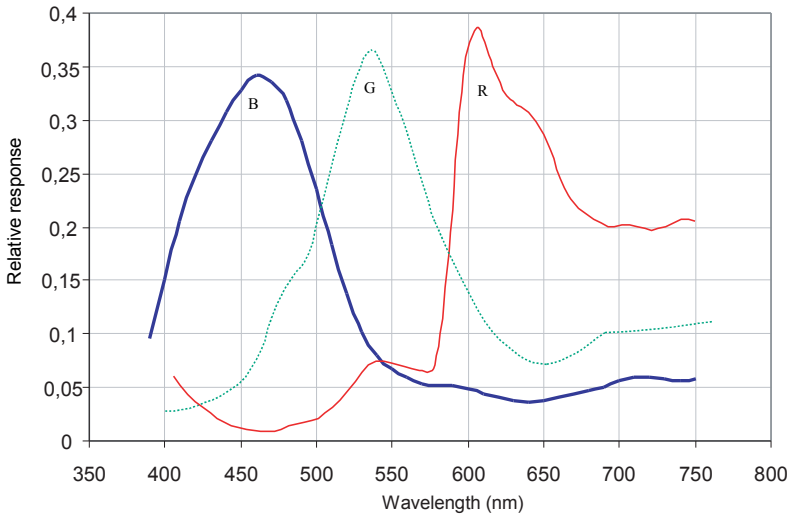


Figure 5: Spectral sensitivity for GC2041 Color

2.2.3. GC2591M / GC2591C

Image sensor	Aptina MT9P031
Sensor type	CMOS
Sensor resolution (H x W)	2592 x 1944
Optical size	1/2.5"
Pixel size (in µm)	2.2 x 2.2
Analog gain (in dB)	0 ÷ 23.5
Shutter	Rolling
Exposure Time	36µs ÷ 10s
Max. frame rate (at full resolution)	14
ADC bit depth	8 bits
Power consumption	2.2W
Weight	90g

Spectral Sensitivity

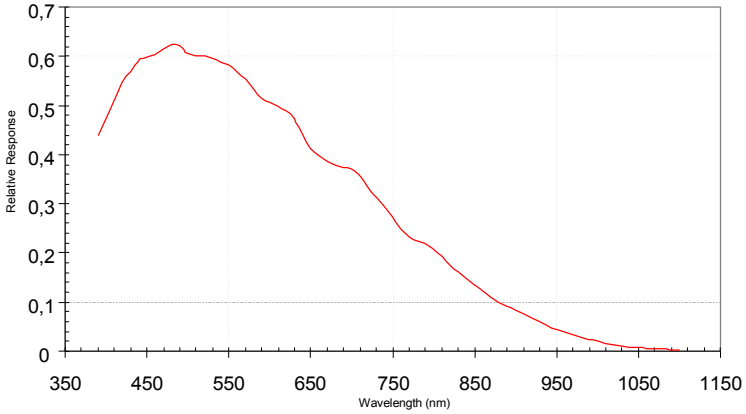


Figure 6: Spectral sensitivity for GC2591 Monochrome

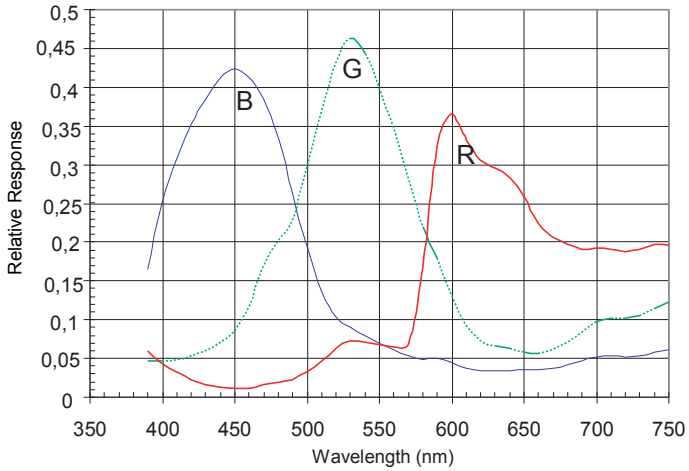


Figure 7: Spectral sensitivity for GC2591 Color

2.2.4. GC3851M / GC3851C

Image sensor	Aptina MT9J003
Sensor type	CMOS
Sensor resolution (H x W)	3856 x 2764
Optical size	1/2.3"
Pixel size (in µm)	1.67 x 1.67
Analog gain (in dB)	0 ÷ 23.5
Shutter	Rolling
Exposure Time	36µs ÷ 10s
Max. frame rate (at full resolution)	7
ADC bit depth	8 bits
Power consumption	2.5W
Weight	90g

Spectral Sensitivity

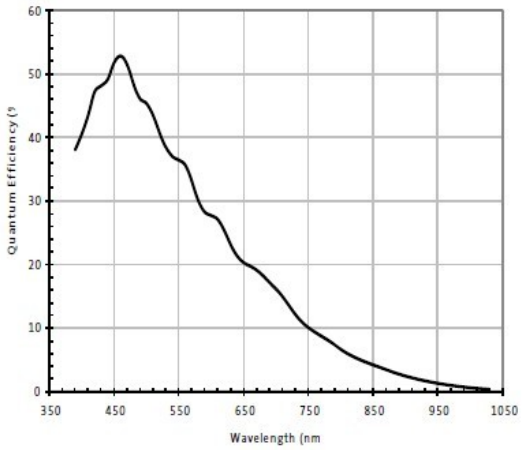


Figure 8: Spectral sensitivity for GC3851 Monochrome

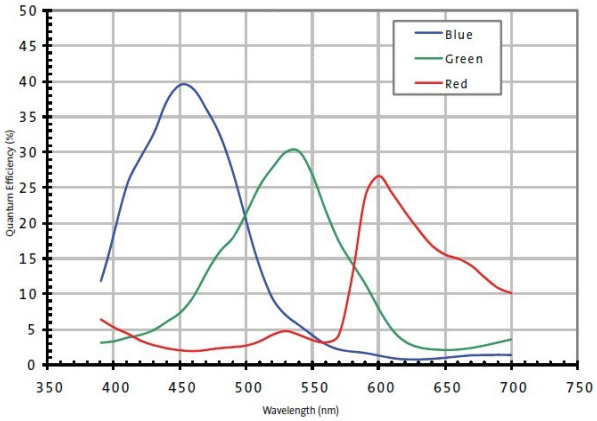


Figure 9: Spectral sensitivity for GC3851 Color

2.2.5. GC651M / GC651C

Image sensor	Sony ICX618
Sensor type	CCD
Sensor resolution (H x W)	659 x 494
Optical size	1/4"
Pixel size (in µm)	5.6 x 5.6
Analog gain (in dB)	0 ÷ 40
Shutter	Full frame
Exposure Time	10µs ÷ 10s
Max. frame rate (at full resolution)	120
ADC bit depth	8 – 14 bits
Power consumption	2.3W
Weight	90g

Spectral Sensitivity

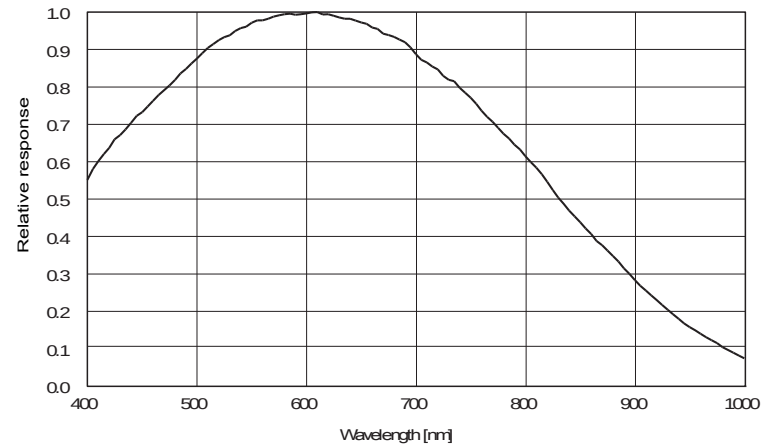


Figure 10: Spectral sensitivity for GC651 Monochrome

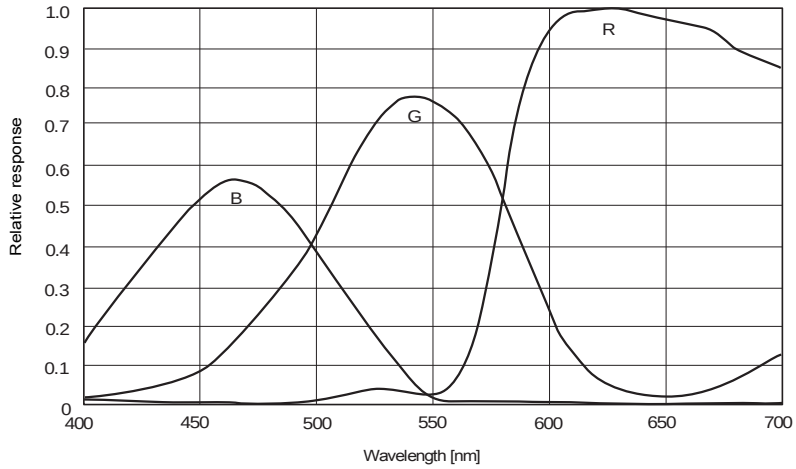


Figure 11: Spectral sensitivity for GC651 Color

2.2.6. GC652M / GC652C

Image sensor	Sony ICX424
Sensor type	CCD
Sensor resolution (H x W)	659 x 494
Optical size	1/3"
Pixel size (in µm)	7.4 x 7.4
Analog gain (in dB)	0 ÷ 40
Shutter	Full frame
Exposure Time	10µs ÷ 10s
Max. frame rate (at full resolution)	90
ADC bit depth	8 – 14 bits
Power consumption	2.6W
Weight	90g

Spectral Sensitivity

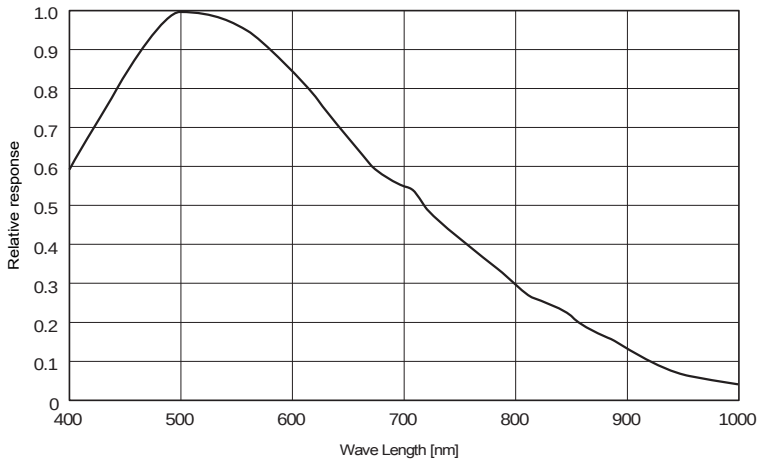


Figure 12: Spectral sensitivity for GC652 Monochrome

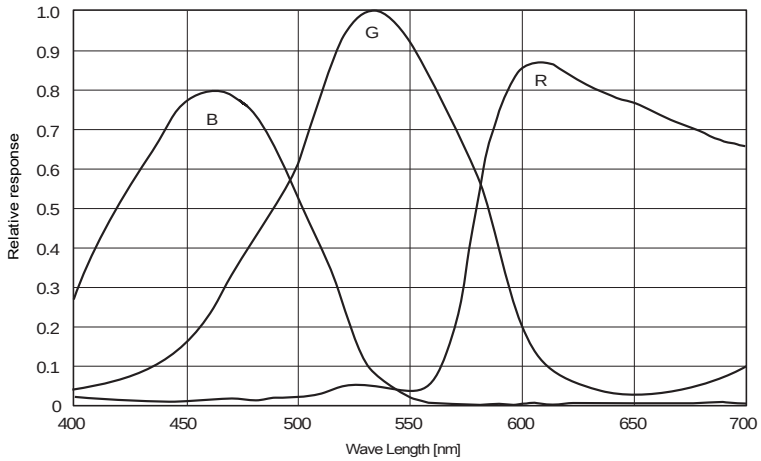


Figure 13: Spectral sensitivity for GC652 Color

2.2.7. GC653M / GC653C

Image sensor	Sony ICX414
Sensor type	CCD
Sensor resolution (H x W)	659 x 494
Optical size	1/2"
Pixel size (in µm)	9.9 x 9.9
Analog gain (in dB)	0 ÷ 40
Shutter	Full frame
Exposure Time	10µs ÷ 10s
Max. frame rate (at full resolution)	90
ADC bit depth	8 – 14 bits
Power consumption	2.6W
Weight	90g

Spectral Sensitivity

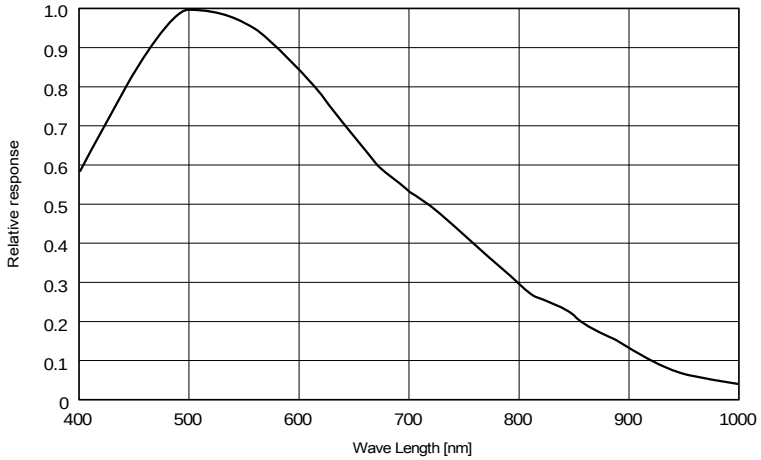


Figure 14: Spectral sensitivity for GC653 Monochrome

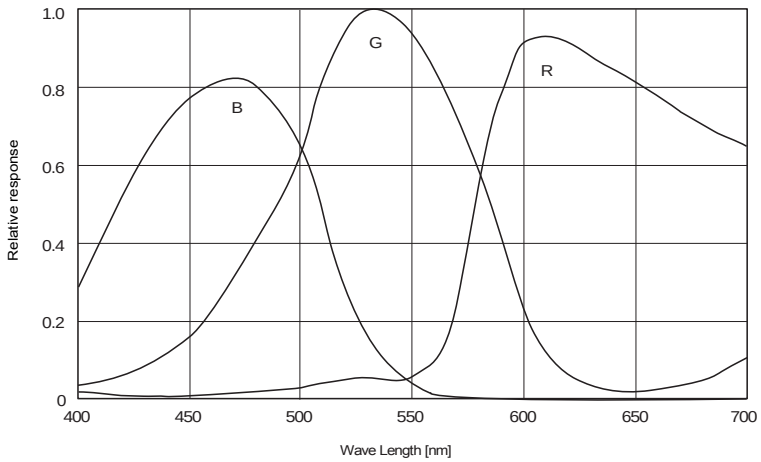


Figure 15: Spectral sensitivity for GC653 Color

2.2.8. GC781M / GC781C

Image sensor	Sony ICX415
Sensor type	CCD
Sensor resolution (H x W)	782 x 582
Optical size	1/2"
Pixel size (in µm)	8.3 x 8.3
Analog gain (in dB)	0 ÷ 40
Shutter	Full frame
Exposure Time	10µs ÷ 10s
Max. frame rate (at full resolution)	64
ADC bit depth	8 – 14 bits
Power consumption	2.6W
Weight	90g

Spectral Sensitivity

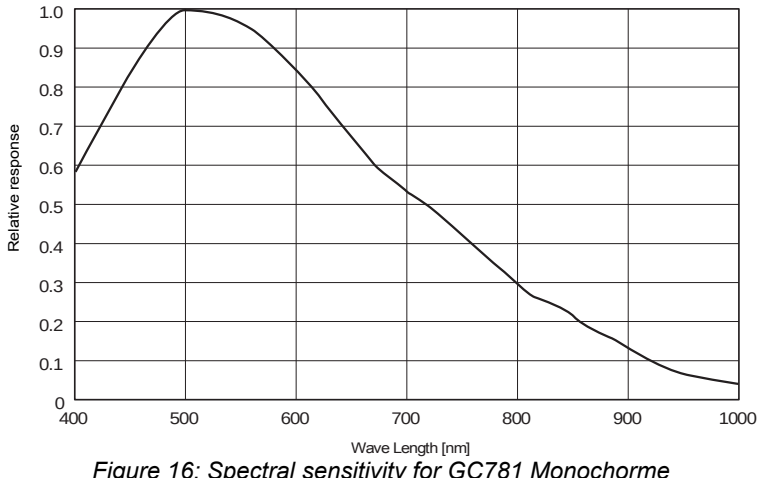


Figure 16: Spectral sensitivity for GC781 Monochorme

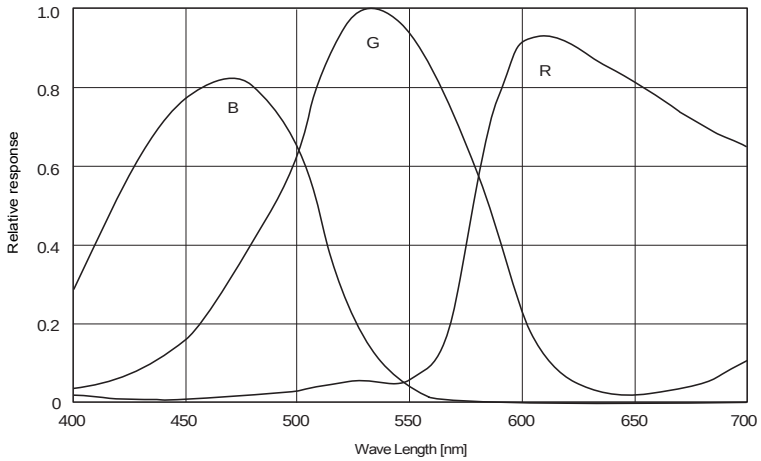


Figure 17: Spectral sensitivity for GC781 Color

2.2.9. GC1031M / GC1031C

Image sensor	Sony ICX204
Sensor type	CCD
Sensor resolution (H x W)	1034 x 779
Optical size	1/3"
Pixel size (in µm)	4.65 x 4.65
Analog gain (in dB)	0 ÷ 40
Shutter	Full frame
Exposure Time	10µs ÷ 10s
Max. frame rate (at full resolution)	30
ADC bit depth	8 – 14 bits
Power consumption	2.2W
Weight	90g

Spectral Sensitivity

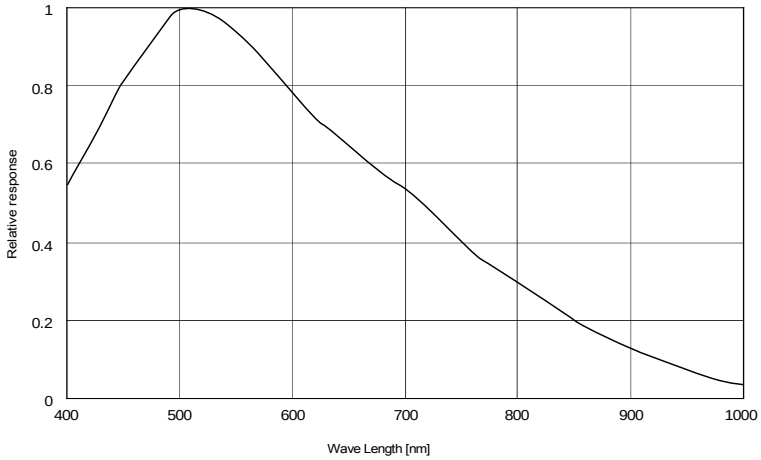


Figure 18: Spectral sensitivity for GC1031 Monochrome

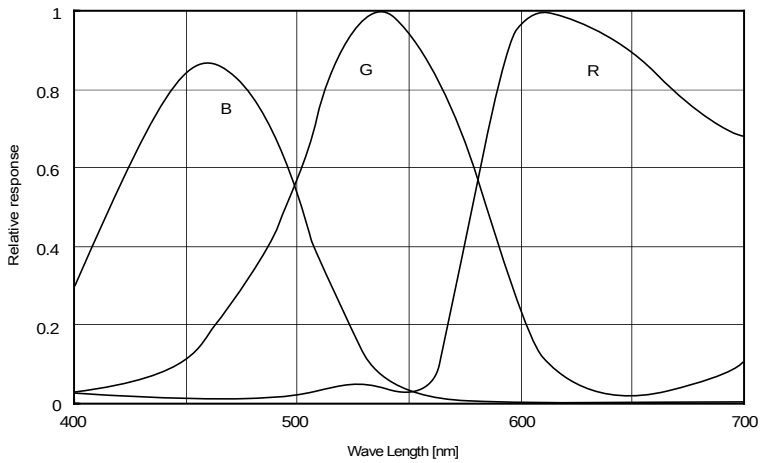


Figure 19: Spectral sensitivity for GC1031 Color

2.2.10. GC1291M / GC1291C

Image sensor	Sony ICX445
Sensor type	CCD
Sensor resolution (H x W)	1296 x 966
Optical size	1/3"
Pixel size (in µm)	3.75 x 3.75
Analog gain (in dB)	0 ÷ 40
Shutter	Full frame
Exposure Time	10µs ÷ 10s
Max. frame rate (at full resolution)	30
ADC bit depth	8 – 14 bits
Power consumption	TBD
Weight	90g

Spectral Sensitivity

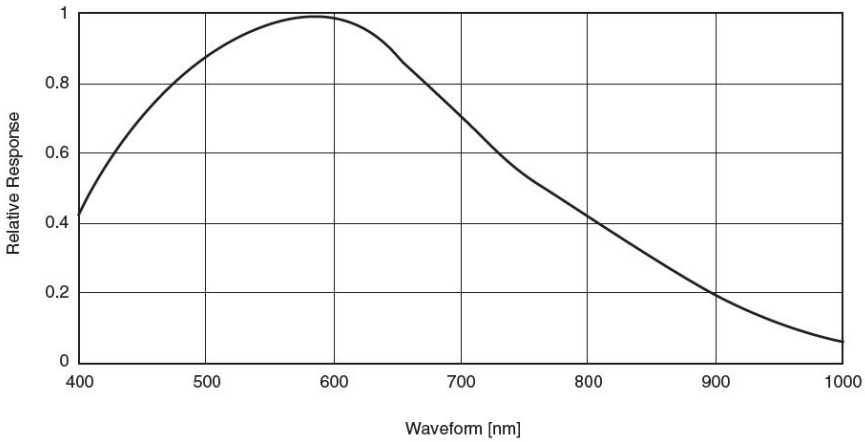


Figure 20: Spectral sensitivity for GC1291 Monochrome

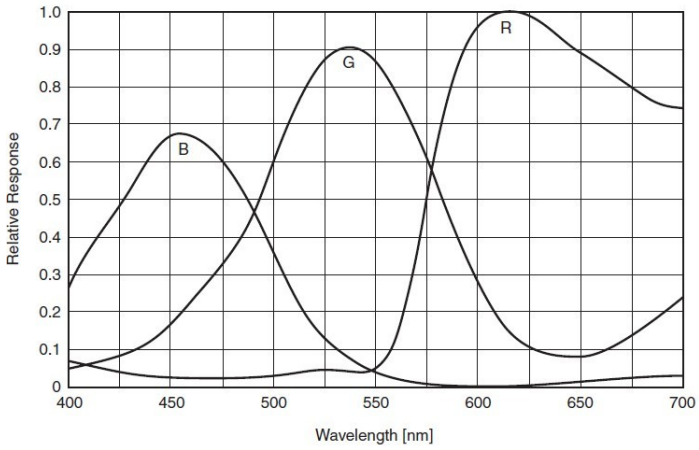


Figure 21: Spectral sensitivity for GC1291 Color

2.2.11. GC1391M / GC1391C

Image sensor	Sony ICX267
Sensor type	CCD
Sensor resolution (H x W)	1392 x 1040
Optical size	1/2"
Pixel size (in µm)	4.65 x 4.65
Analog gain (in dB)	0 ÷ 40
Shutter	Full frame
Exposure Time	10µs ÷ 10s
Max. frame rate (at full resolution)	20
ADC bit depth	8 – 14 bits
Power consumption	2.5W
Weight	90g

Spectral Sensitivity

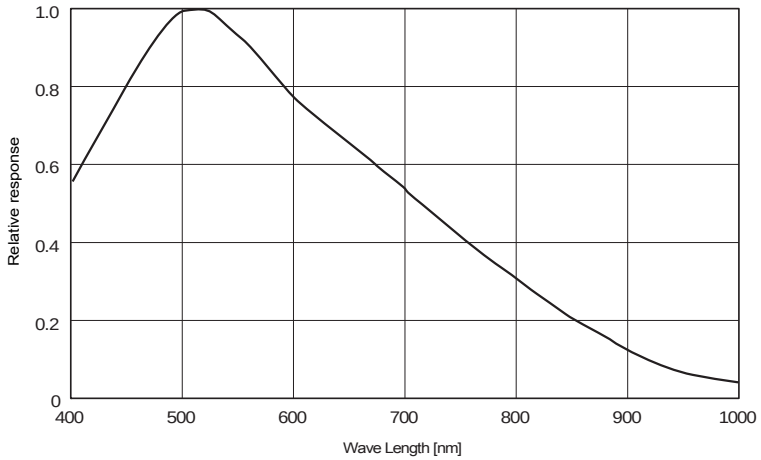


Figure 22: Spectral sensitivity for GC1391 Monochrome

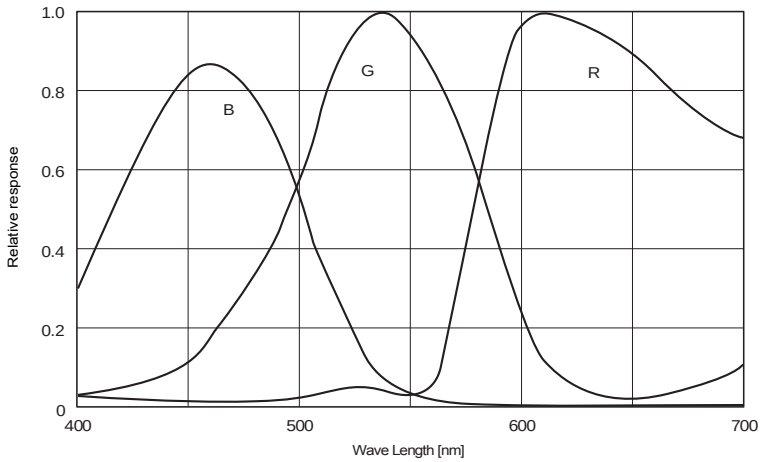


Figure 23: Spectral sensitivity for GC1391 Color

2.2.12. GC1392M / GC1392C

Image sensor	Sony ICX285
Sensor type	CCD
Sensor resolution (H x W)	1392 x 1040
Optical size	2/3"
Pixel size (in µm)	6.45 x 6.45
Analog gain (in dB)	0 ÷ 40
Shutter	Full frame
Exposure Time	10µs ÷ 10s
Max. frame rate (at full resolution)	30
ADC bit depth	8 – 14 bits
Power consumption	2.8W
Weight	90g

Spectral Sensitivity

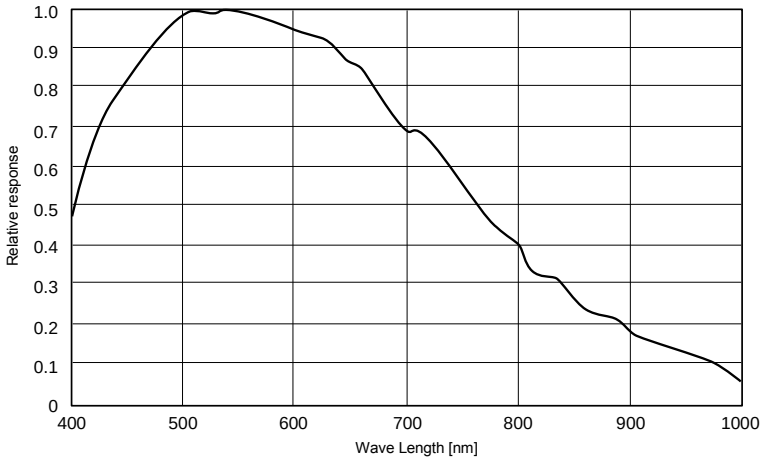


Figure 24: Spectral sensitivity for GC1392 Monochrome

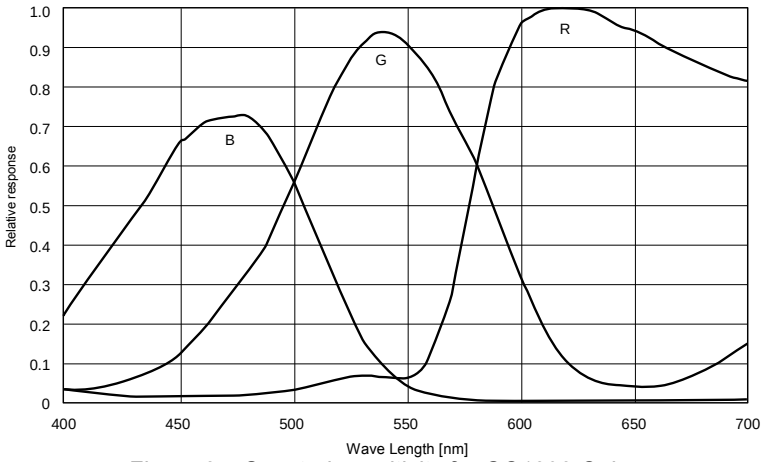


Figure 25: Spectral sensitivity for GC1392 Color

2.2.13. GC1621M / GC1621C

Image sensor	Sony ICX274
Sensor type	CCD
Sensor resolution (H x W)	1628 x 1236
Optical size	1/1.8"
Pixel size (in µm)	4.4 x 4.4
Analog gain (in dB)	0 ÷ 40
Shutter	Full frame
Exposure Time	10µs ÷ 10s
Max. frame rate (at full resolution)	25
ADC bit depth	8 – 14 bits
Power consumption	2.7W
Weight	90g

Spectral Sensitivity

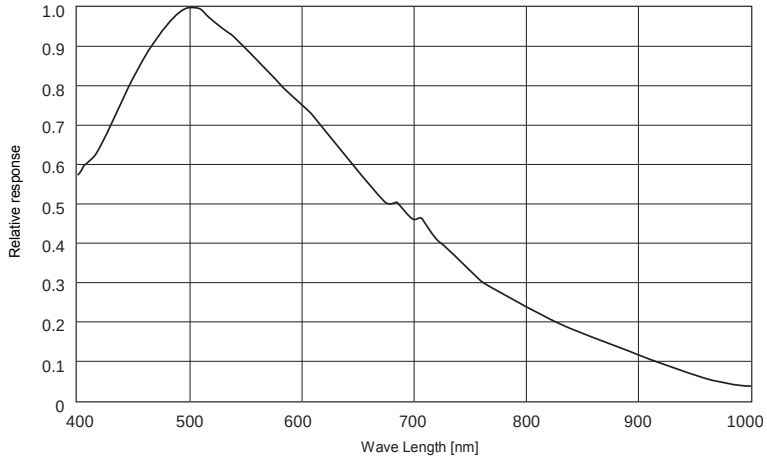


Figure 26: Spectral sensitivity for GC1621 Monochrome

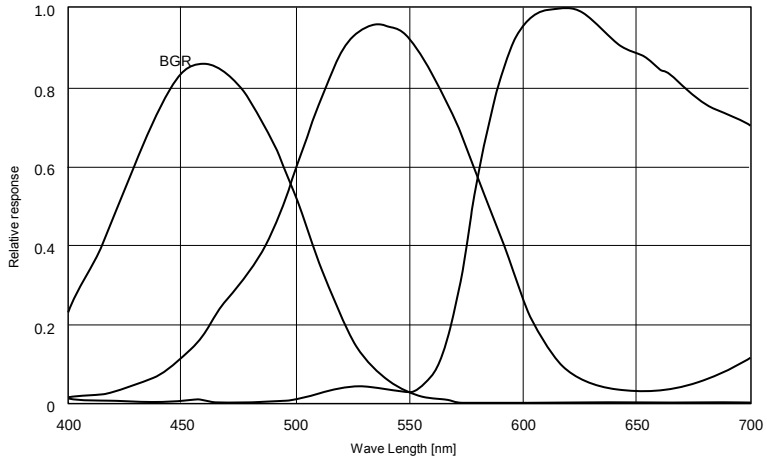


Figure 27: Spectral sensitivity for GC1621 Color

2.2.14. GC2441M / GC2441C

Image sensor	Sony ICX625
Sensor type	CCD
Sensor resolution (H x W)	2448 x 2050
Optical size	2/3"
Pixel size (in µm)	3.45 x 3.45
Analog gain (in dB)	0 ÷ 40
Shutter	Full frame
Exposure Time	10µs ÷ 10s
Max. frame rate (at full resolution)	15
ADC bit depth	8 – 14 bits
Power consumption	3.6W
Weight	90g

Spectral Sensitivity

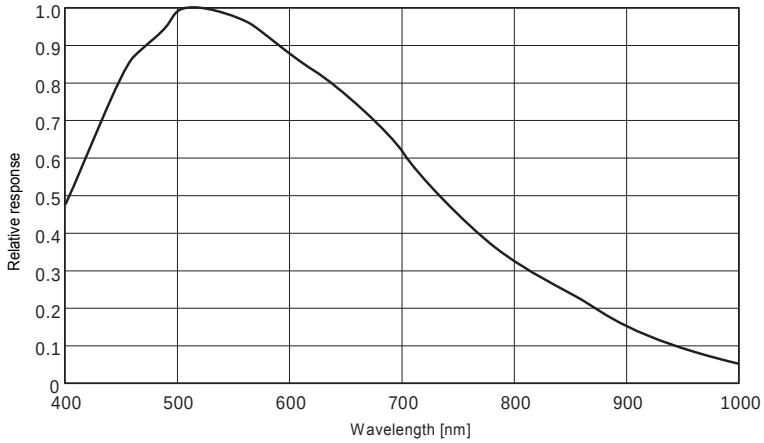


Figure 28: Spectral sensitivity for GC2441 Monochrome

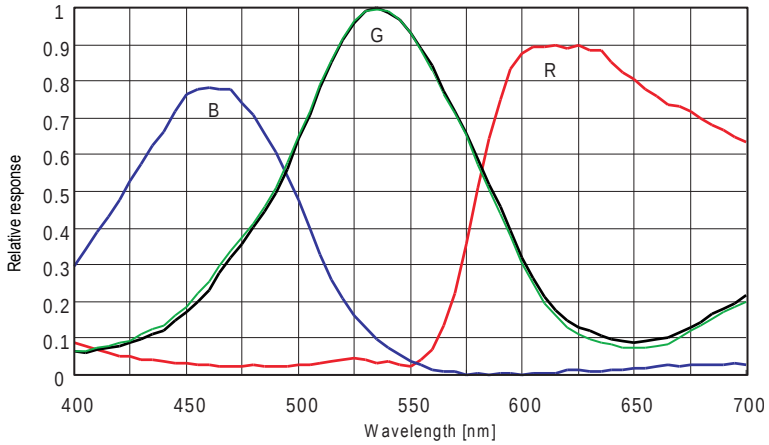


Figure 29: Spectral sensitivity for GC2441 Color

2.2.15. GC1021M / GC1021C

Image sensor	Kodak KAI-01050
Sensor type	CCD
Sensor resolution (H x W)	1024 x 1024
Optical size	1/2"
Pixel size (in µm)	5.5 x 5.5
Analog gain (in dB)	0 ÷ 40
Shutter	Full frame
Exposure Time	10µs ÷ 10s
Max. frame rate (at full resolution)	60
ADC bit depth	8 – 14 bits
Power consumption	TBD
Weight	90g

Spectral Sensitivity

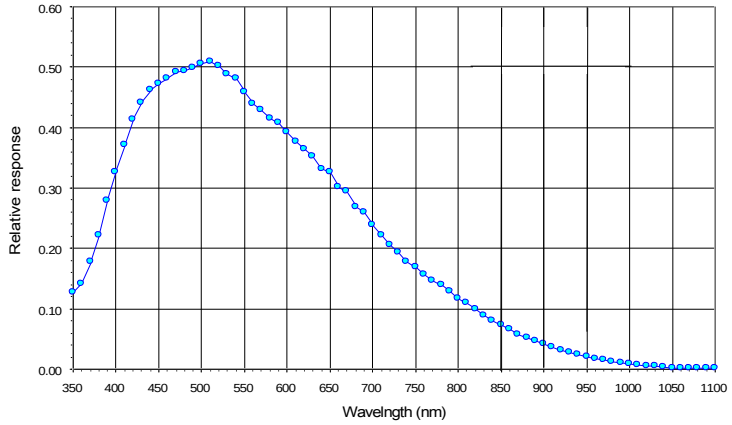


Figure 30: Spectral sensitivity for GC1021 Monochrome

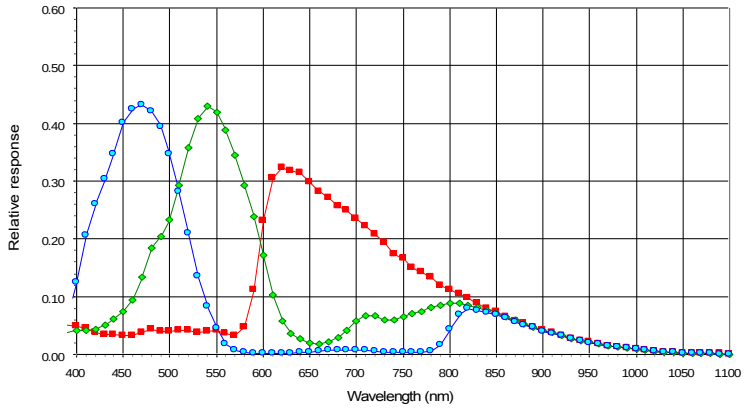


Figure 31: Spectral sensitivity for GC1021 Color

2.2.16. GC1601M / GC1601C

Image sensor	Kodak KAI-02050
Sensor type	CCD
Sensor resolution (H x W)	1600 x 1200
Optical size	2/3"
Pixel size (in µm)	5.5 x 5.5
Analog gain (in dB)	0 ÷ 40
Shutter	Full frame
Exposure Time	10µs ÷ 10s
Max. frame rate (at full resolution)	30
ADC bit depth	8 – 14 bits
Power consumption	TBD
Weight	90g

Spectral Sensitivity

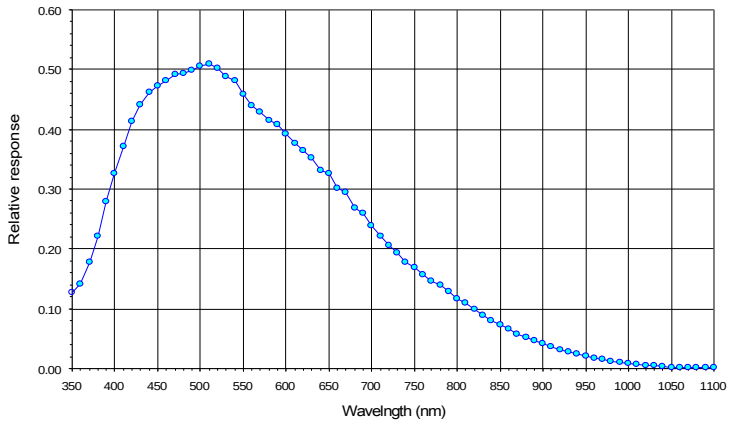


Figure 32: Spectral sensitivity for GC1601 Monochrome

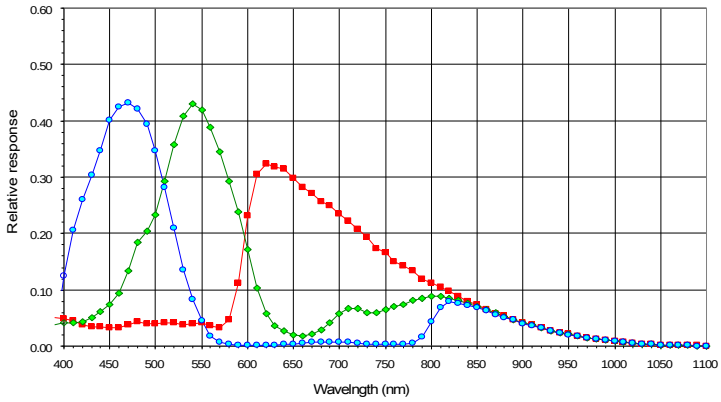


Figure 33: Spectral sensitivity for GC1601 Color

2.2.17. GC1921M / GC1921C

Image sensor	Kodak KAI-02150
Sensor type	CCD
Sensor resolution (H x W)	1920 x 1080
Optical size	2/3"
Pixel size (in µm)	5.5 x 5.5
Analog gain (in dB)	0 ÷ 40
Shutter	Full frame
Exposure Time	10µs ÷ 10s
Max. frame rate (at full resolution)	32
ADC bit depth	8 – 14 bits
Power consumption	TBD
Weight	90

Spectral Sensitivity

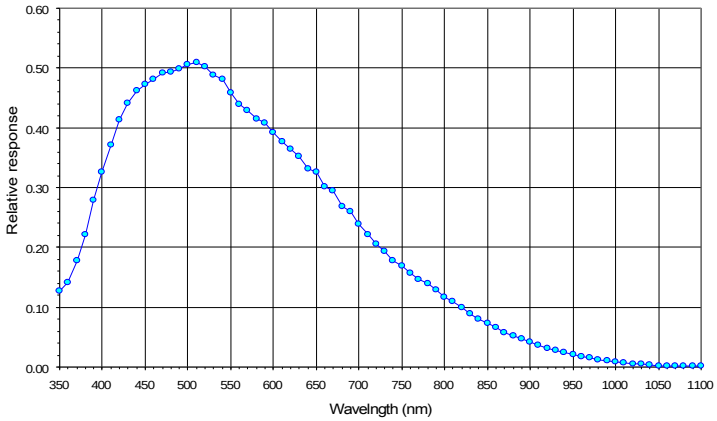


Figure 34: Spectral sensitivity for GC1921 Monochrome

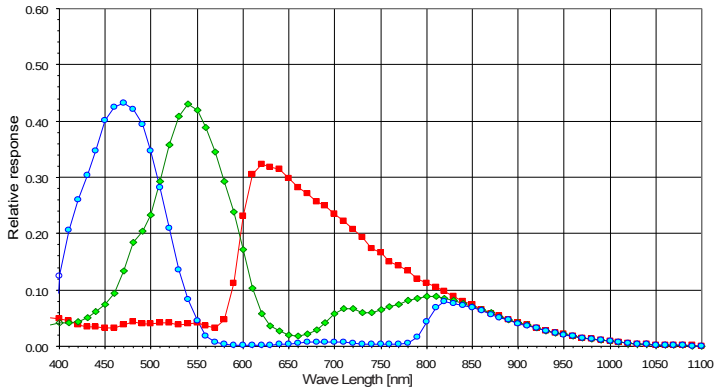


Figure 35: Spectral sensitivity for GC1921 Color

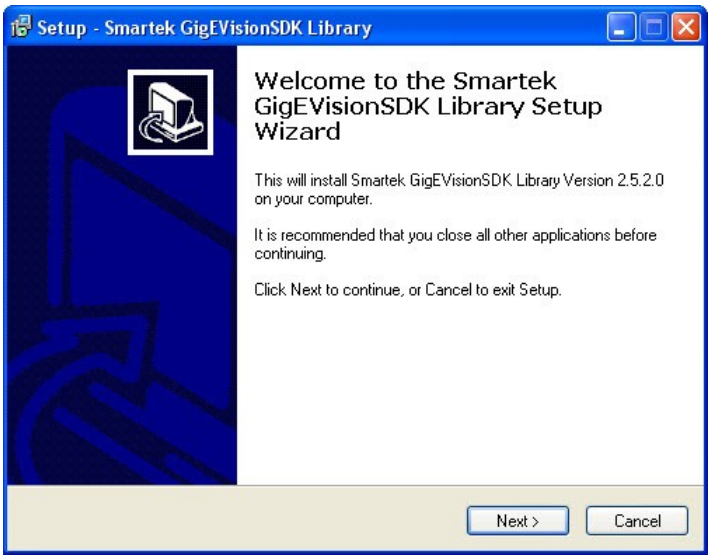
3. *GigEVisionSDK* library for Windows

3.1. *GigEVisionSDK* library installation

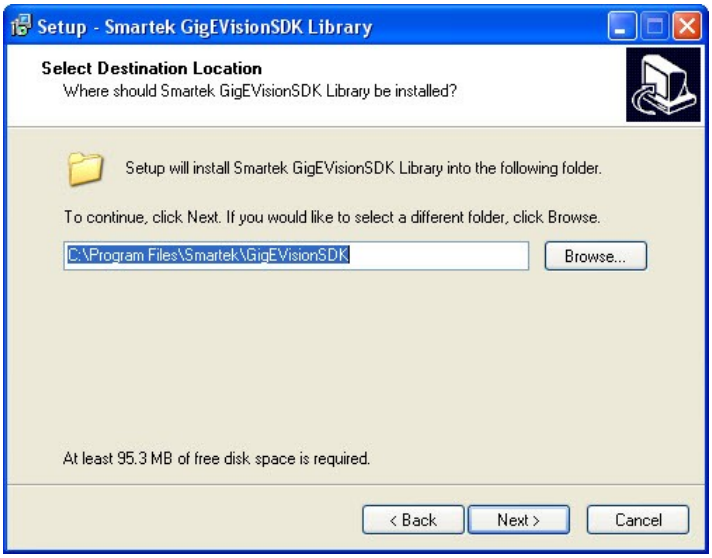
Before camera can transfer images to PC, *GigEVisionSDK* library must be installed on PC properly. Follow those steps in order to install the software on your PC.

Step 1: To start the installation run the Smartek *GigEVisionSDK* library installation.

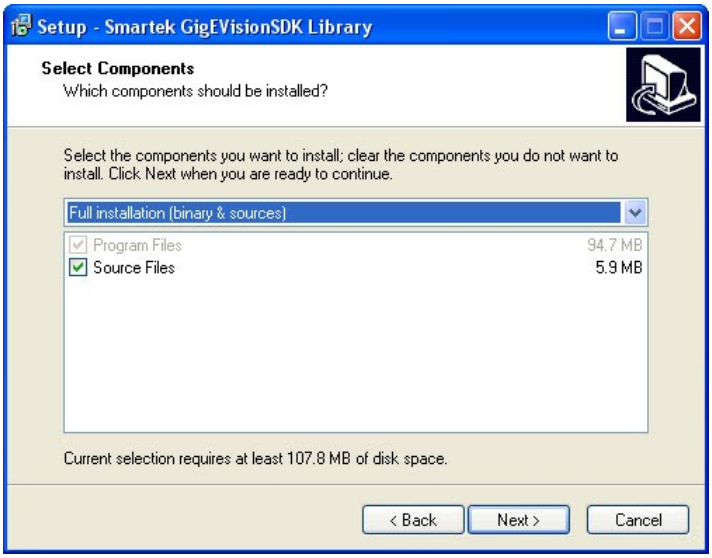
Step 2: Setup screen appears, click **Next**.


Setup - Smartek GigEVisionSDK Library
Welcome to the Smartek GigEVisionSDK Library Setup Wizard
This will install Smartek GigEVisionSDK Library Version 2.5.2.0 on your computer.
It is recommended that you close all other applications before continuing.
Click Next to continue, or Cancel to exit Setup.
Next >
Cancel

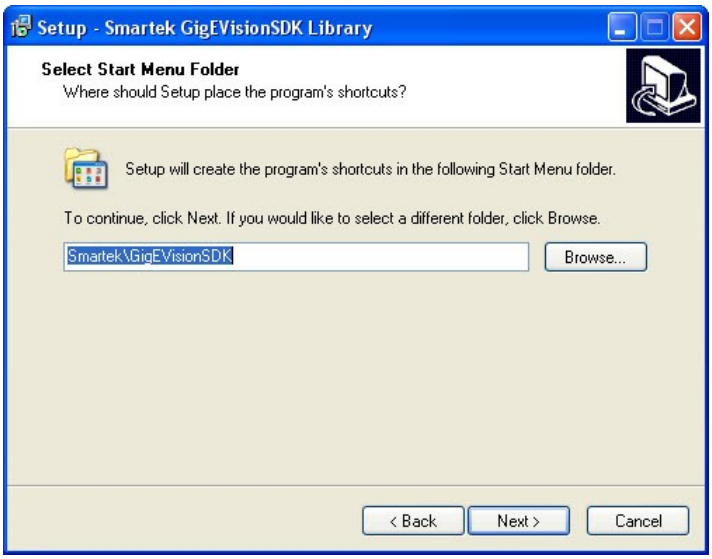
Step 3: Click **Browse** to select the destination folder, or just click **Next** to install the software in the default folder.


Setup - Smartek GigEVisionSDK Library
Select Destination Location
Where should Smartek GigEVisionSDK Library be installed?
Setup will install Smartek GigEVisionSDK Library into the following folder.
To continue, click Next. If you would like to select a different folder, click Browse.
C:\Program Files\Smartek\GigEVisionSDK
Browse...
At least 95.3 MB of free disk space is required.
< Back
Next >
Cancel

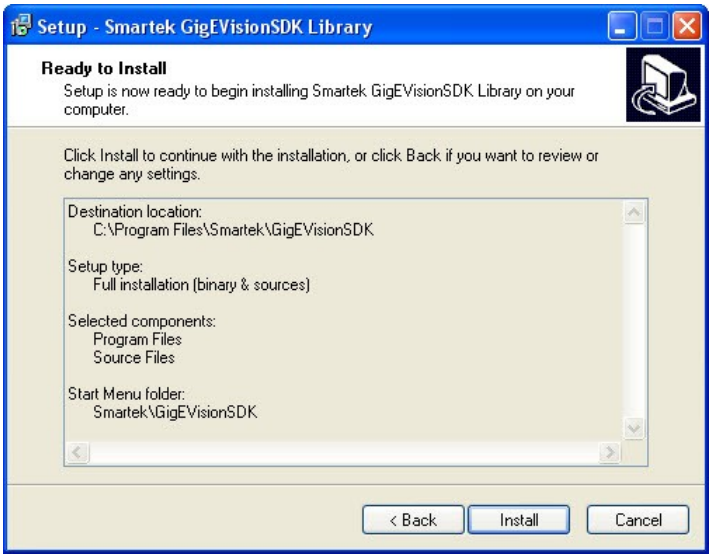
Step 4: Select which components to install on the drop down menu, or click **Next** to continue with full installation.


Setup - Smartek GigEVisionSDK Library
Select Components
Which components should be installed?
Select the components you want to install; clear the components you do not want to install. Click Next when you are ready to continue.
Full installation (binary & sources)
Program Files 94.7 MB
Source Files 5.9 MB
Current selection requires at least 107.8 MB of disk space.
< Back
Next >
Cancel

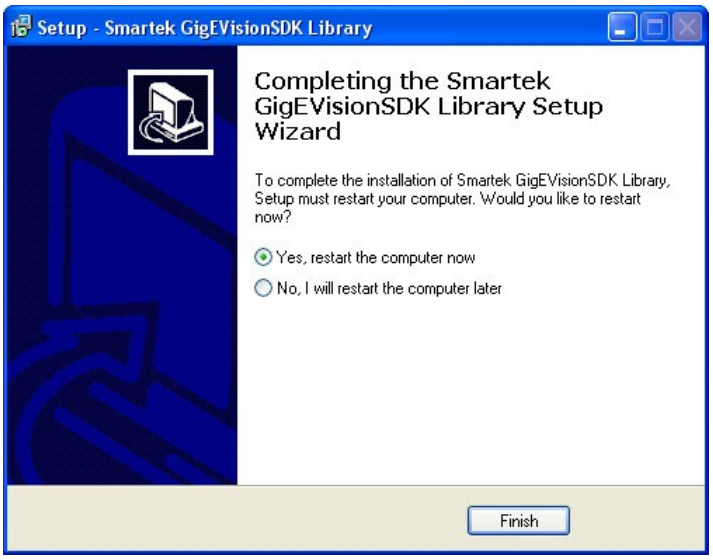
Step 5: Click **Browse** to select different folder, or click **Next** to install to the default *Start menu* folder.


Setup - Smartek GigEVisionSDK Library
Select Start Menu Folder
Where should Setup place the program's shortcuts?
Setup will create the program's shortcuts in the following Start Menu folder.
To continue, click Next. If you would like to select a different folder, click Browse.
Smartek\GigEVisionSDK
Browse...
< Back
Next >
Cancel

Step 6: To install software click **Install**. Installation will install *Smartek Filter Driver* and Windows will show a warning messages, click **Continue Anyway** every time.


Setup - Smartek GigEVisionSDK Library
Ready to Install
Setup is now ready to begin installing Smartek GigEVisionSDK Library on your computer.
Click Install to continue with the installation, or click Back if you want to review or change any settings.
Destination location:
C:\Program Files\Smartek\GigEVisionSDK
Setup type:
Full installation (binary & sources)
Selected components:
Program Files
Source Files
Start Menu folder:
Smartek\GigEVisionSDK
< Back
Install
Cancel

Step 7: To complete the installation click **Finish** and wait for your PC to reboot.


Setup - Smartek GigEVisionSDK Library
Completing the Smartek GigEVisionSDK Library Setup Wizard
To complete the installation of Smartek GigEVisionSDK Library, Setup must restart your computer. Would you like to restart now?
Yes, restart the computer now
No, I will restart the computer later
Finish

3.2. Connecting camera

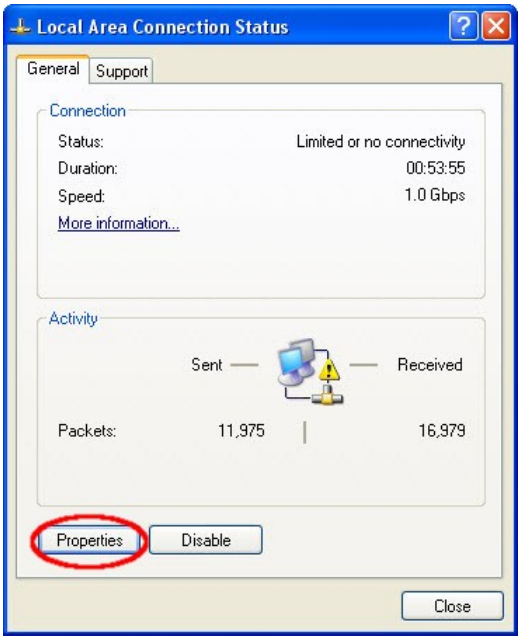
Now that everything is installed, connect the camera to PC. It can be connected to PC either via Gigabit Ethernet switch or peer to peer with Ethernet cable. Make sure your firewall settings are not blocking communications with camera. If that is the case, firewall must be turned off. In order to turn off the firewall in Windows, find *Windows Firewall* under *Control Panel* and turn it off.

3.2.1. Connecting peer to peer with Ethernet cable

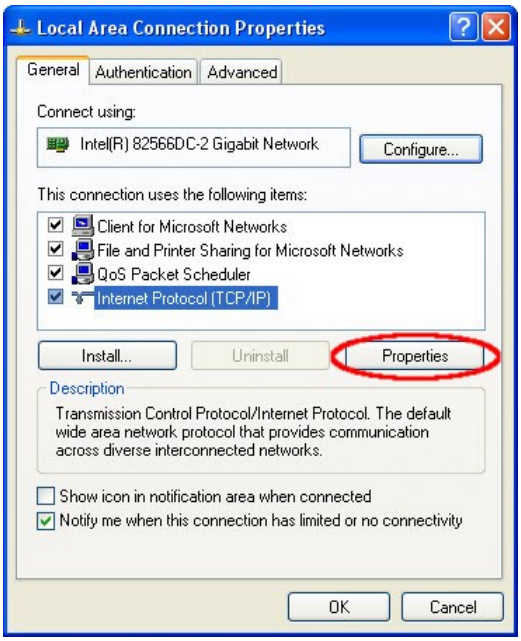
Make sure that the *Local Area Connection* in your *Network Connections* settings to which the camera is connected is enabled. Now PC will try to acquire network address, in case your IP address is not fixed the following message will appear.

Local Area Connection
This connection has limited or no connectivity. You might not be able to access the Internet or some network resources. For more information, click this message.

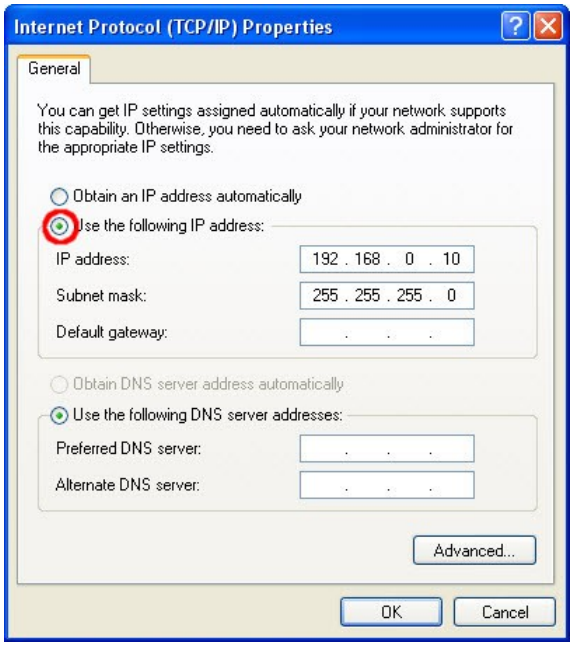
This means that an IP address should be provided manually. To provide IP address manually, right-click on the *Local Area Connection* to which the camera is connected and press **Properties** button.



Now select *Internet Protocol [TCP/IP]* and press **Properties** button.

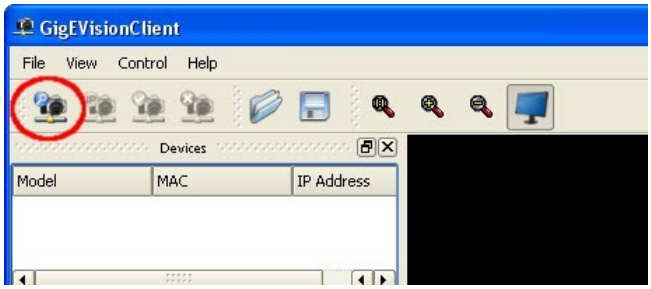


Enable *Use the following IP address* and type in, for example the numbers that are shown in the figure below. Note: In order for camera to be connectable, the IP address that is provided manually should be on the same subnet as the camera's IP address.


Internet Protocol (TCP/IP) Properties
General
You can get IP settings assigned automatically if your network supports this capability. Otherwise, you need to ask your network administrator for the appropriate IP settings.
Obtain an IP address automatically
Use the following IP address:
IP address:
192 . 168 . 0 . 10
Subnet mask:
255 . 255 . 255 . 0
Default gateway:
Obtain DNS server address automatically
Use the following DNS server addresses:
Preferred DNS server:
Alternate DNS server:
Advanced...
OK
Cancel

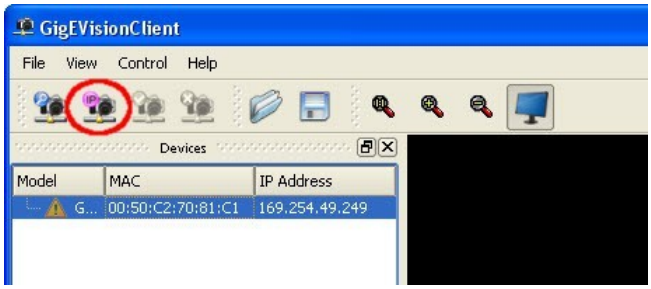
3.2.2. Connecting *GigEVisionClient* with the camera

Run the *GigEVisionClient* and click **Find Devices** icon to start searching for devices.

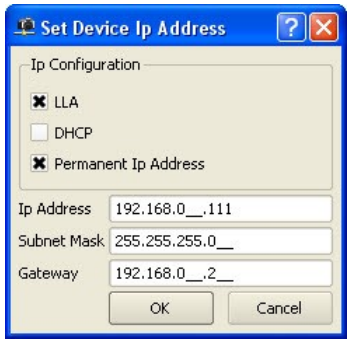


If no camera has been found check your hardware and software settings. Make sure everything is plugged properly and your firewall settings are not blocking connection to the camera. If you still experience problem please contact Smartek support.

If camera is connected peer to peer with Ethernet cable or via Ethernet switch and no DHCP server is installed, search result can look something like in the picture below. Cameras are shipped in DHCP mode, and in case DHCP server does not exist, camera obtains the IP address using Link-Local Address (LLA) IP configuration protocol. If there is a warning symbol next to the camera model name, the application is unable to connect to the camera because the camera and the PC are on different subnet. Change IP address of the device to be on the same subnet as the IP address in *Local Area Connection* settings. To change the IP address of the camera click on the **Set Ip To Device** icon.



New window will open. Here you can set the new IP address, subnet mask and gateway. Make sure you don't provide the same IP address to camera as in *Local Area Connection* settings.

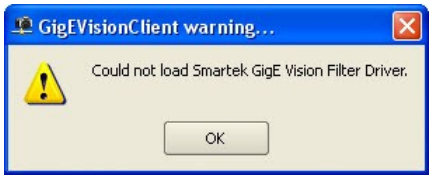


Select the camera that is found and click on the **Connect Device** icon to connect to the camera.

3.3. Filter driver installation

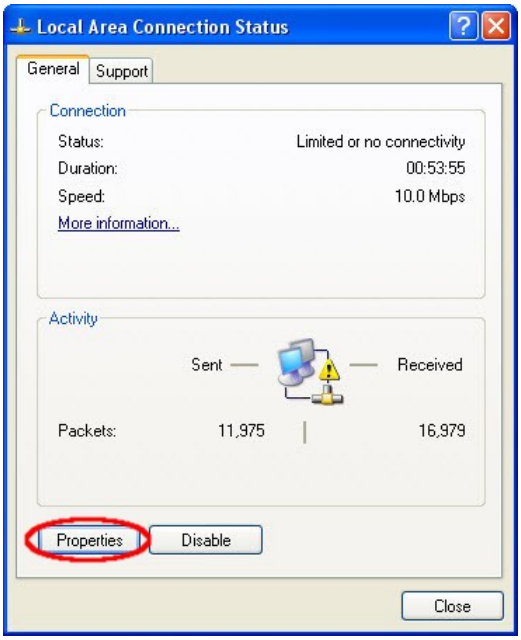
Smartek provides its own filter driver to ensure optimal performance of the digital camera. This driver is compatible with GigE Vision standard. *Smartek Filter Driver* separates incoming packets containing image data from the other traffic on the network, making the image data flow from the camera to the software more efficient.

If *GigEVisionClient* is started without the *Smartek Filter Driver,* the following warning message appears.

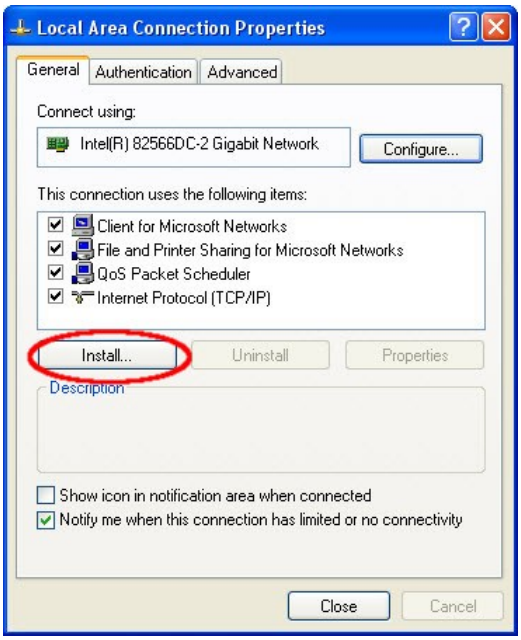


There is also a warning message in the top bar “Warning: Smartek Filter Driver not loaded”. Follow this steps to install the *Smartek Filter Drive*r:

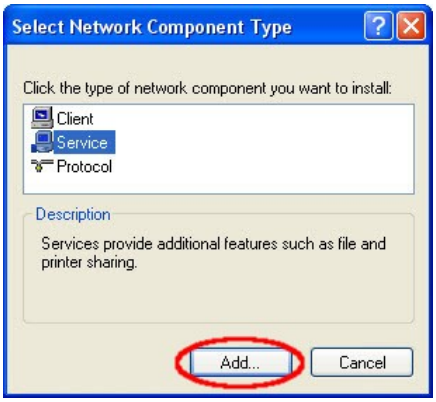
Step 1: Open the *Local Area Connection* in your *Network Connections* settings to which the camera is connected, and press **Properties** button.



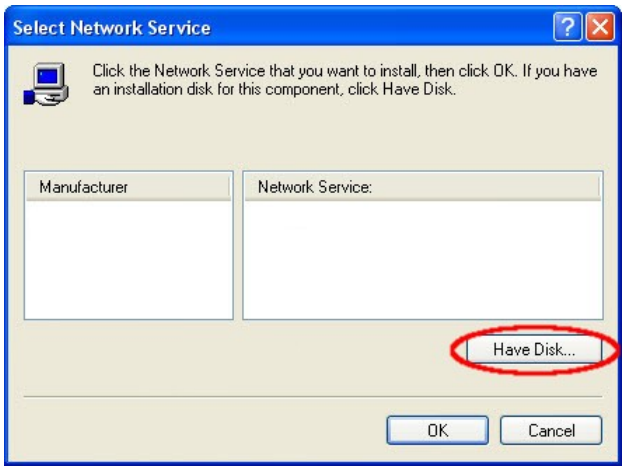
Step 2: Click on the **Install** button.



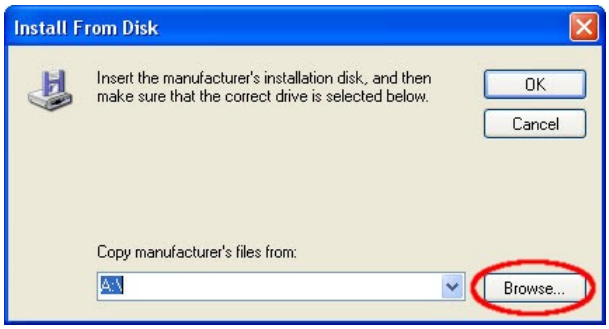
Step 3: Select *Service* and click **Add** button.



Step 4: Click **Have Disk** to select a driver to install.


Select Network Service
Click the Network Service that you want to install, then click OK. If you have an installation disk for this component, click Have Disk.
Manufacturer
Network Service:
Have Disk...
OK
Cancel

Step 5: To select a source folder click **Browse**.


Install From Disk
Insert the manufacturer's installation disk, and then make sure that the correct drive is selected below.
OK
Cancel
Copy manufacturer's files from:
Browse...

Step 6: Go to directory where GigEVisionSDK is installed and locate under "`\drivers\FilterDriver`" files `GigEVDrv.inf` and `GigEVDrv_m.inf`. Pick one of them! Note: either one will work.

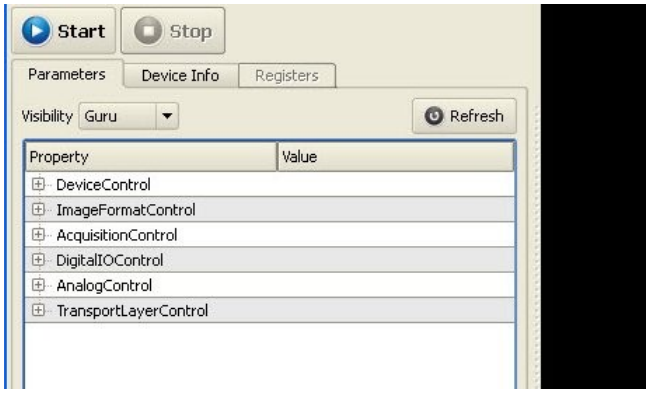
Step 9: Windows will show a warning messages, click **Continue Anyway** every time it shows up.

Hardware Installation
The software you are installing for this hardware:
Smartek GigE Vision Miniport
has not passed Windows Logo testing to verify its compatibility with Windows XP. (Tell me why this testing is important.)
Continuing your installation of this software may impair or destabilize the correct operation of your system either immediately or in the future. Microsoft strongly recommends that you stop this installation now and contact the hardware vendor for software that has passed Windows Logo testing.
Continue Anyway
STOP Installation

Smartek Filter Driver is installed.

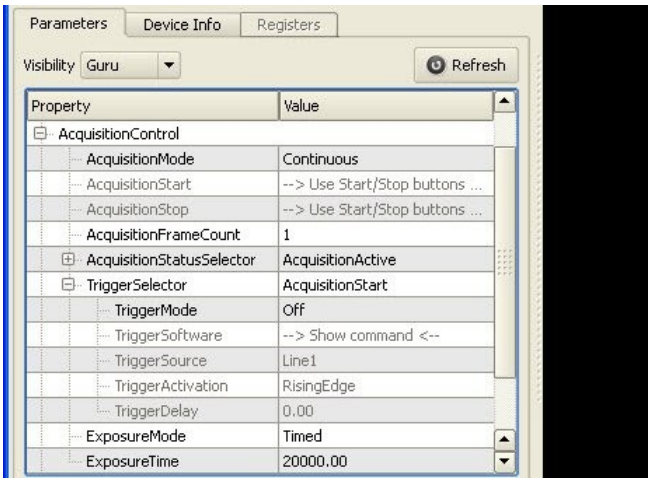
4. *GigEVisionClient* features

General information about the camera selected from the list of discovered devices is displayed under ***Device Info*** tab. Under ***Parameters*** tab there is a tree of features extracted from GenICam camera description file.



4.1. Acquisition control

The *AcquisitionControl* section describes all features related to image acquisition, including the trigger and exposure control. It describes the basic model for acquisition and the typical behavior of the device.



4.1.1. Acquisition mode

The *AcquisitionMode* property controls the acquisition mode of the device. It defines the number of frames captured during the acquisition and the way the acquisition stops. It can take any of the following values:

- *Continuous* – frames are captured continuously until stopped with the *AcquisitionStop* command
- *SingleFrame* – camera captures only one frame.
- *MultiFrame* – camera captures a specific number of frames (number of frames is set under the *AcquisitionFrameCount*).

In order for the camera to run in “continuous frame” or “free run” mode, in which camera acquires and transfers images at maximum supported frame rate, *AcquisitionMode* must be set to *Continuous* and *TriggerMode* must be set to *Off*. When in *SingleFrame* or *MultiFrame* mode, camera acquires certain number of frames and then acquisition is stopped.

4.1.2. Trigger mode

TriggerMode activates/deactivates trigger operation. It can take any of the following values:

- *On* – enables trigger operation
- *Off* – disables trigger operation

Once again, setting the *TriggerMode* property to *Off* and the *AcquisitionMode* property to *Continuous* places the camera into “free run” mode.

4.1.3. Trigger source

TriggerSource specifies the internal signal or physical input line to use as the trigger source. The selected trigger must have its *TriggerMode* set to *On*. *TriggerSource* can take any of the following values:

- *Software* – specifies that the trigger source will be generated by software using the *TriggerSoftware* command.
- *Line1, Line2* – specifies which physical line (or pin) and associated I/O control block to use as external source for the trigger signal.

4.1.4. Trigger activation

TriggerActivation specifies the activation mode of the trigger. *TriggerActivation* can take any of the following values:

- *RisingEdge* – specifies that the trigger is considered valid on the rising edge of the source signal.
- *FallingEdge* – specifies that the trigger is considered valid on the falling edge of the source signal.

4.1.5. Exposure

Exposure feature defines the sensor integration time. It is a time the image sensor is converting incoming light into electronic charge in pixels before transferring the frame off the chip. Exposure duration can be set and is expressed in microseconds. See *3.4. Sensor information and technical specification (all models separate)* for definition of default exposure and exposure range for each image sensor.

ExposureMode feature is used to set the operation mode of the Exposure. The default value is *Timed*:

- *Timed* – enables exposure. The exposure duration time is set by using the *ExposureTime.*

Example of different *ExposureTime* settings. In the left picture *ExposureTime* is set to 10000 µs, and in the right it is set to 22000 µs.

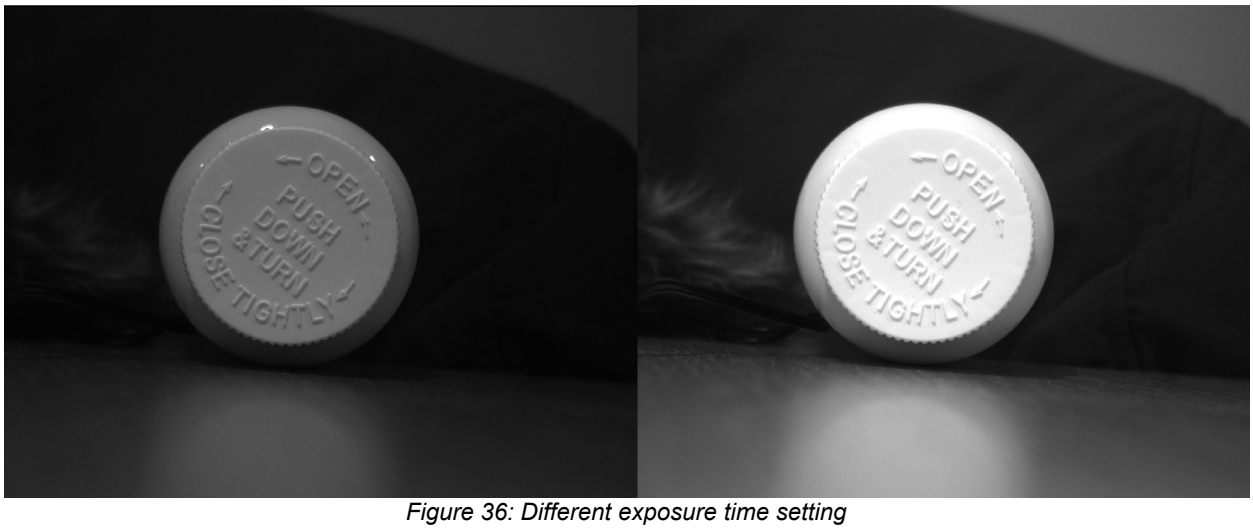
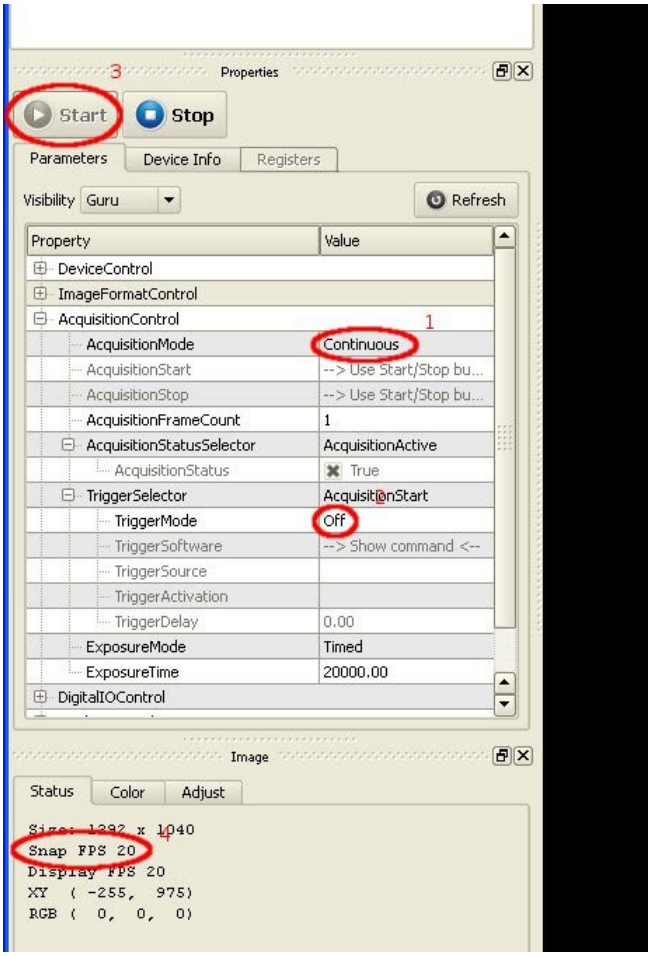


Figure 36: Different exposure time setting

4.1.6. Test your camera

Set *AcquisitionMode* to *Continuous*(1), *TriggerMode* to *Off*(2) and click **Start**(3)**.** The image should appear on the screen.



Note: if the image display is all black and the *Snap FPS*(4) value is above zero, than try opening the lens iris. If you are still experiencing problem, please contact Smartek support.

4.2. External trigger

External trigger is used when the camera needs to be synchronized to external trigger event. The camera can be triggered on the rising or the falling edge of the input trigger signal. The minimum width of the external trigger signal is defined by the trigger debouncer time property.

4.2.1. Trigger latency

Trigger latency is time expressed in microseconds which shows how long it takes for camera to detect an external trigger input. Trigger latency can't be modified. Please compare this important feature with other manufacturers.

4.2.2. Trigger delay

Trigger delay is a delay from input trigger to exposure start and is expressed in µs. Trigger delay can be set.

4.2.3. Trigger edge

- *Rising edge* – exposure starts on the rising edge of the trigger.
- *Falling edge* – exposure starts on the falling edge of the trigger.

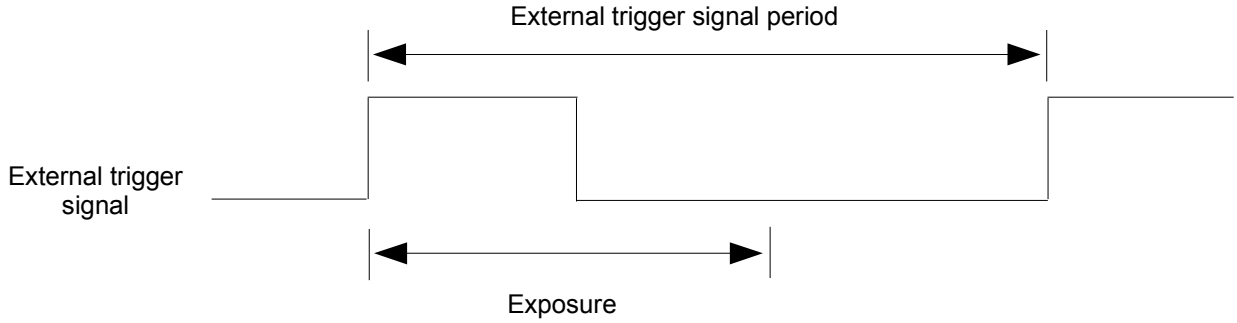


Figure 37: Exposure with rising edge of the trigger

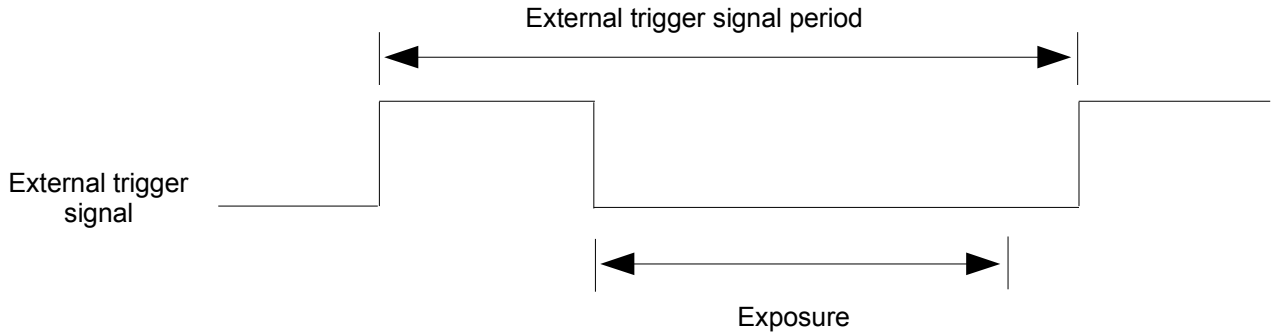


Figure 38: Exposure with a falling edge of the trigger

4.2.4. Trigger debouncer

Trigger debouncer time defines minimum time interval that input signal must remain active in order to be recognized as valid trigger input signal. Trigger debouncer is used to prevent possible unwanted trigger events. It eliminates short noises that could easily be interpreted as trigger signals. The function of the trigger debouncer is shown in the figure below: two glitches are ignored by the debouncer because the width of those signals is shorter than the debouncer time value, while the third signal is accepted as valid trigger signal because it's width is longer than the debouncer time limit. *TriggerDebouncerTime* feature is used to set trigger debouncer time expressed in µs. Trigger debouncer time effectively increases delay time between external trigger signal and internal trigger signal used to start the exposure, so it should be set large enough so as to filter unwanted glitches to trigger the camera and small enough to keep the delay as small as possible.

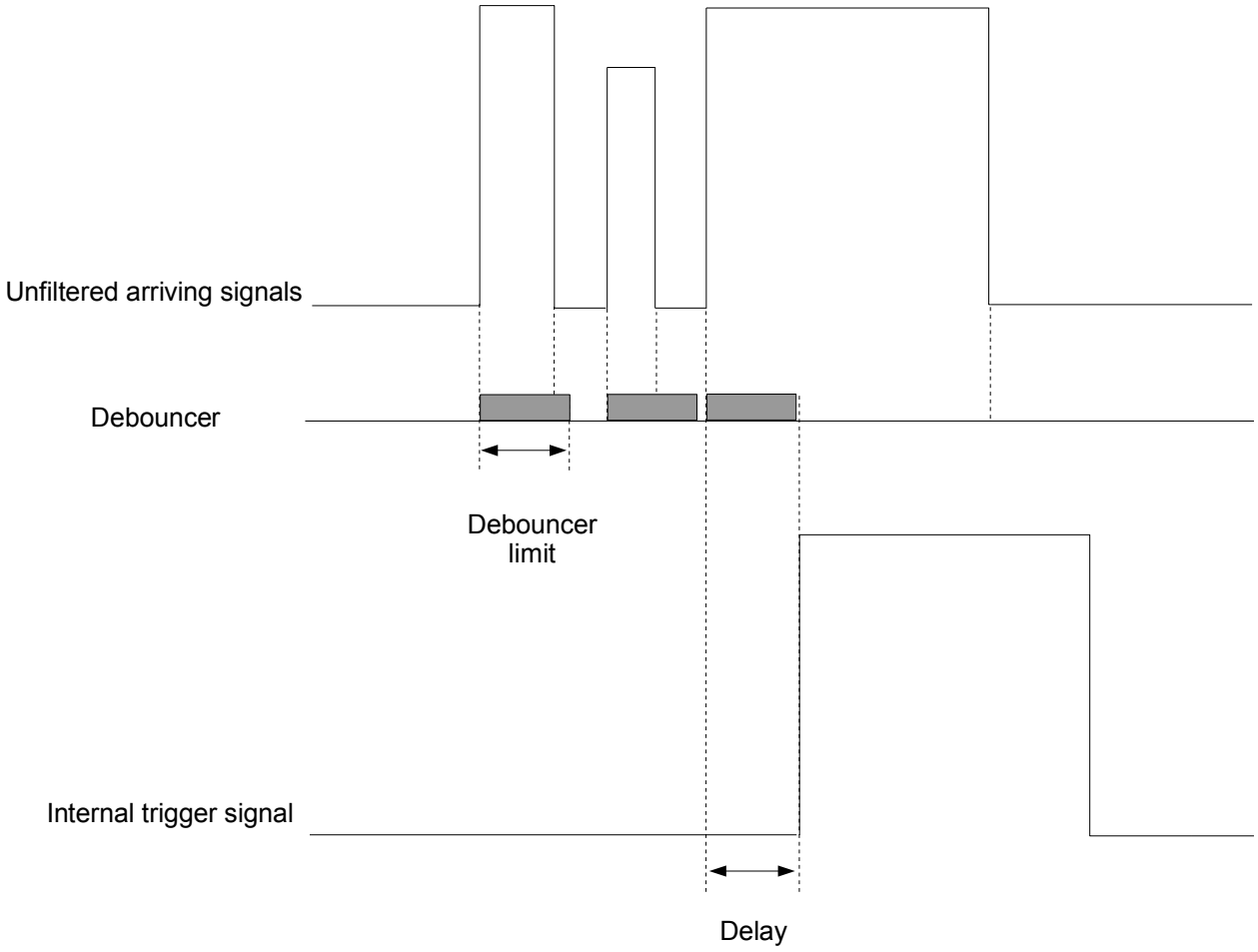


Figure 39: Trigger debouncer function

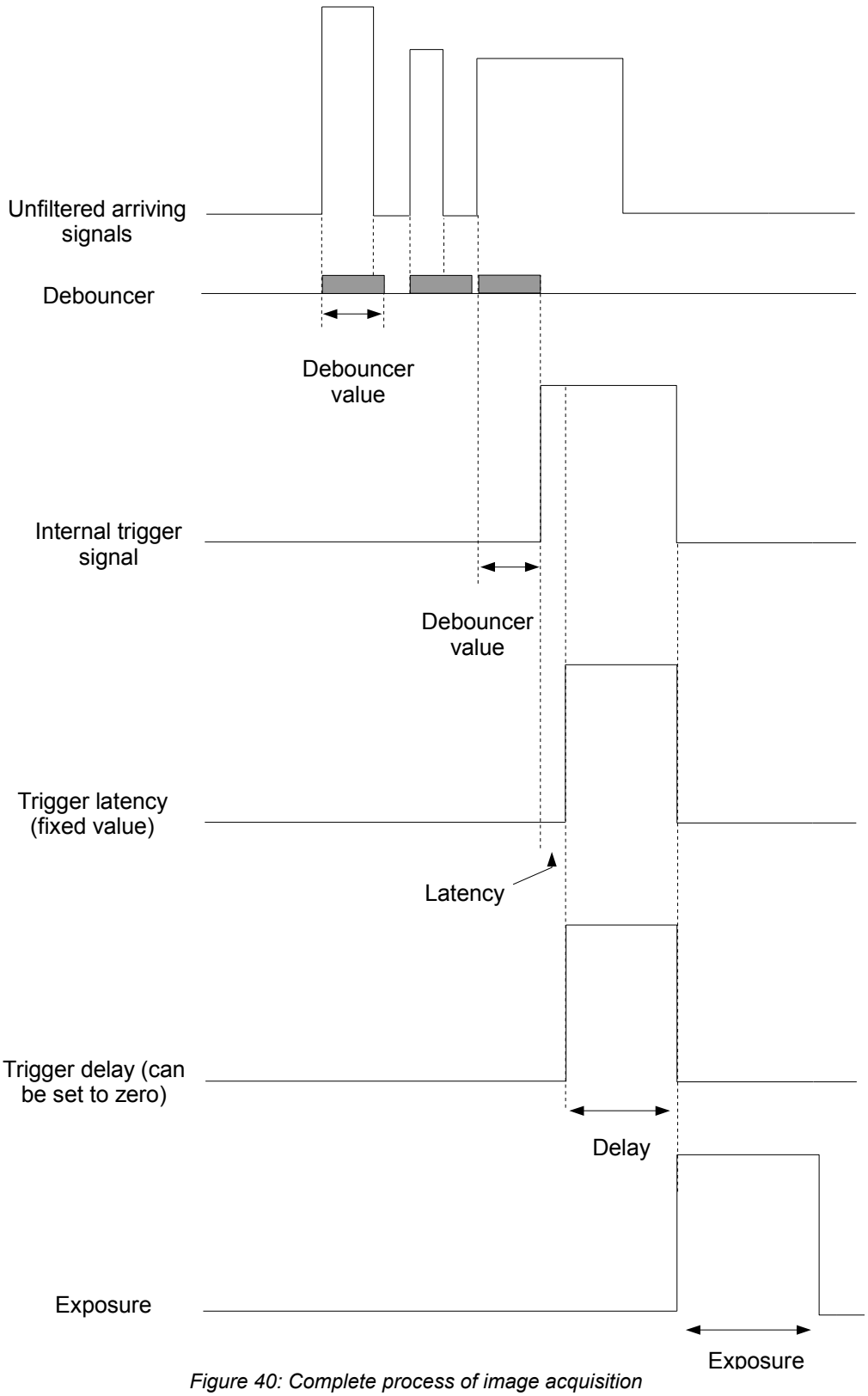


Figure 40: Complete process of image acquisition

4.3. Parallel exposure and sensor readout

The image acquisition process on the camera includes two distinct parts. The first part is the exposure of the pixels in the image sensor. Once exposure is complete, the second part of the process readout of the pixel values from the sensor takes place. As you can see, running the camera with readout and exposure overlapped can allow higher acquisition frame rates because the camera is performing two processes at once.

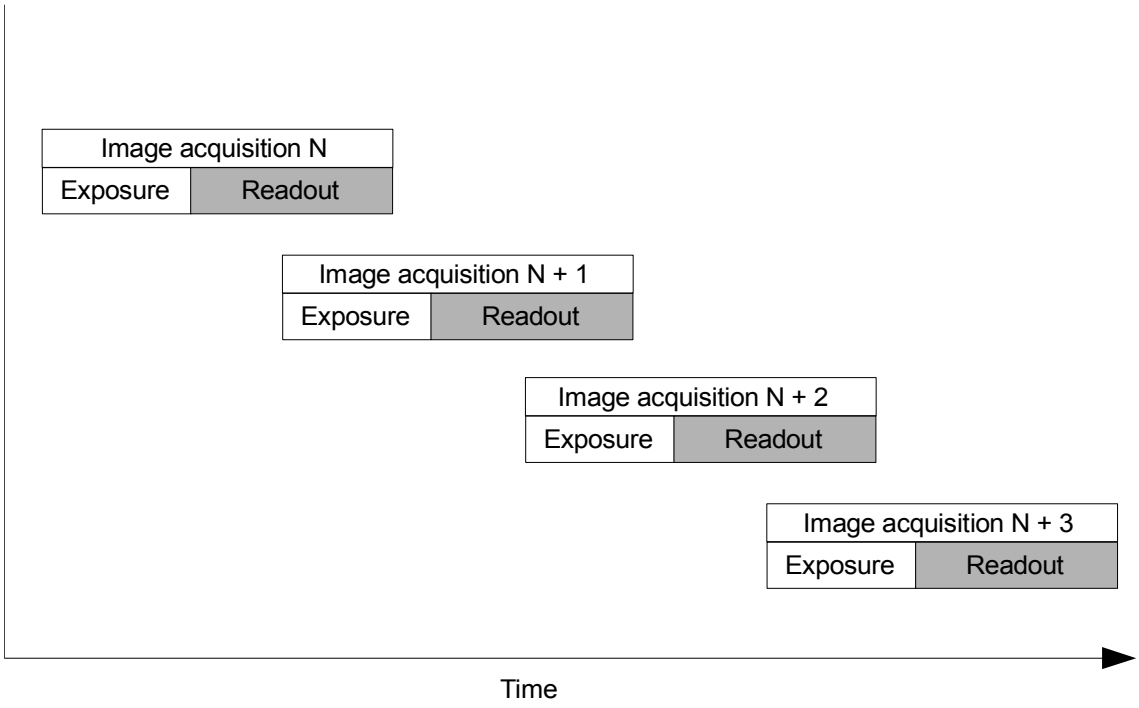


Figure 41: Parallel exposure and readout

4.4. Acquisition frame rate

When camera is configured in “continuous frame” or “free run” mode, *AcquisitionMode* is set to *Continuous* and *TriggerMode* is set to *Off*, it continuously acquires and transmits images at maximum supported frame rate. Using *AcquisitionFrameRate* feature it is possible to decrease the number of frames camera acquires and transmits in “free run” mode, which, consequently, lowers the Ethernet bandwidth needed by the camera. This is useful in situations where Ethernet bandwidth is limited, like connecting several cameras to the PC which can acquire images at faster speed than is needed by application. For example, if the camera is transferring images at 70 MB/s (2Mpix camera at 35 fps), it is not possible to connect two of them to a single port PC network card because of the Ethernet bandwidth limitation. Setting acquisition frame rate to 20 fps, camera is using only 40 MB/s so there is enough bandwidth left for the second camera to transfer images.

Setting *AcquisitionFrameRate* property to zero effectively disables the feature allowing the camera to acquire and transfer images at maximum frame rate.

4.5. Inter packet delay

This feature is used when connecting multiple cameras to one PC. If multiple cameras are connected to PC and inter packet delay feature isn't used, excessive collision between packets may occur and data may be lost. In order to avoid that, delay between packets can be defined. This feature ensures that none of data is lost and all packets are transferred safely to their destination.

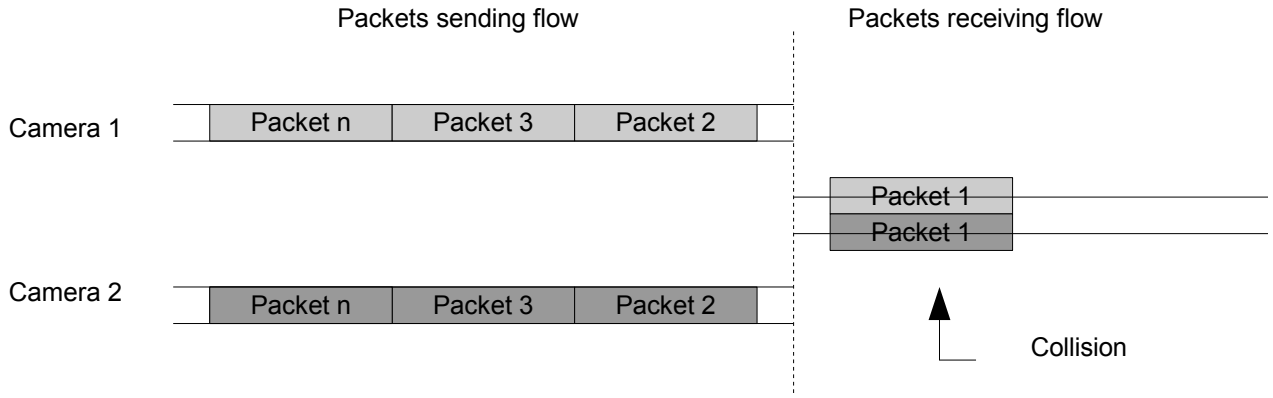


Figure 42: Without inter packet delay

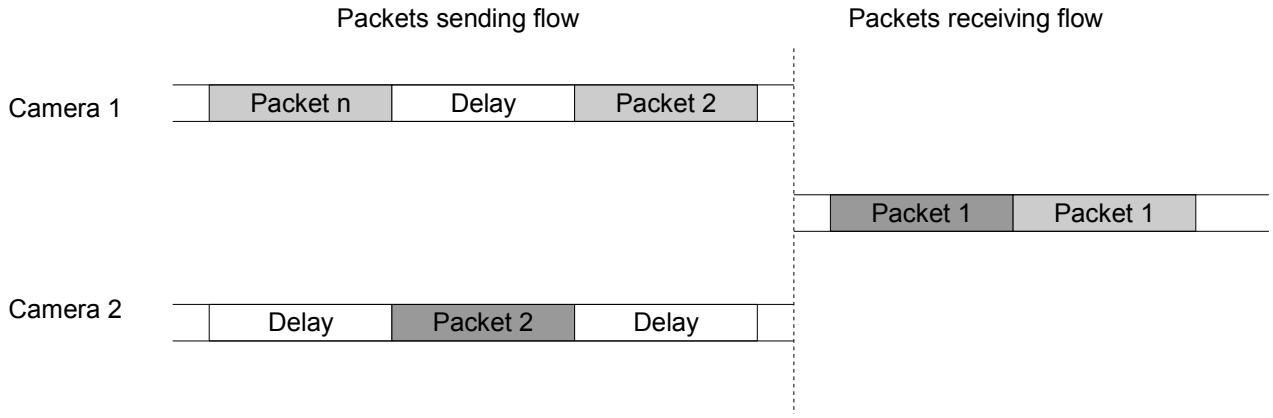


Figure 43: Using inter packet delay

4.5.1. Setting inter packet delay

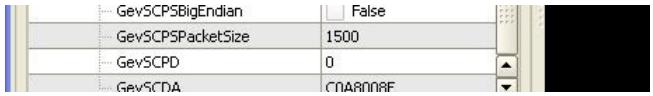


Figure 44: Packet size and inter packet delay

In *TransportLayerControl* section there are features *GevSCPSPacketSize* and *GevSCPD*. *GevSCPD* feature represents inter packet delay and is expressed in microseconds. This value can range from 0 to 1000 µs. Inter packet delay should be set according to number of cameras connected to certain PC and packet size, but care must be taken not to decrease acquisition frame rate. Default inter packet delay on the camera is defined as (packet size)/100 µs, meaning that default inter packet delay for 1500 byte packets is 15 µs.

GevSCPSPacketSize feature represents the size of packets and is expressed in bytes. When GigEVisionClient connects to camera, it tests for maximum available packet size. Default camera packet size is 1500 bytes, but it can be larger if network hardware supports jumbo frames.

Assuming packet size is 1500 bytes (actual Ethernet packet size including inter-frame gap, preamble, header and CRC on the wire is 1538 bytes), maximum of 81274 packets are sent every second via Ethernet interface, which means that time required to transfer one packet is 12,3 µs. Delay should be a bit longer than time required to transfer one packet, in order to ensure that packets from second camera will fit in the vacant time slot. On the other hand, if the camera is producing 60000 packets per second (50 frames per second, 1200 packets per frame), total transfer time must not exceed 16,67 µs if frame rate is to be preserved.

Example: Three cameras are connected to one PC, and are sending 1500 byte packets each. Delay should be such that packets from all three cameras are serialized to PC NIC interface. Setting inter packet delay to 30µs will ensure that packets from other two cameras will fit in the gap between two consecutive packets.

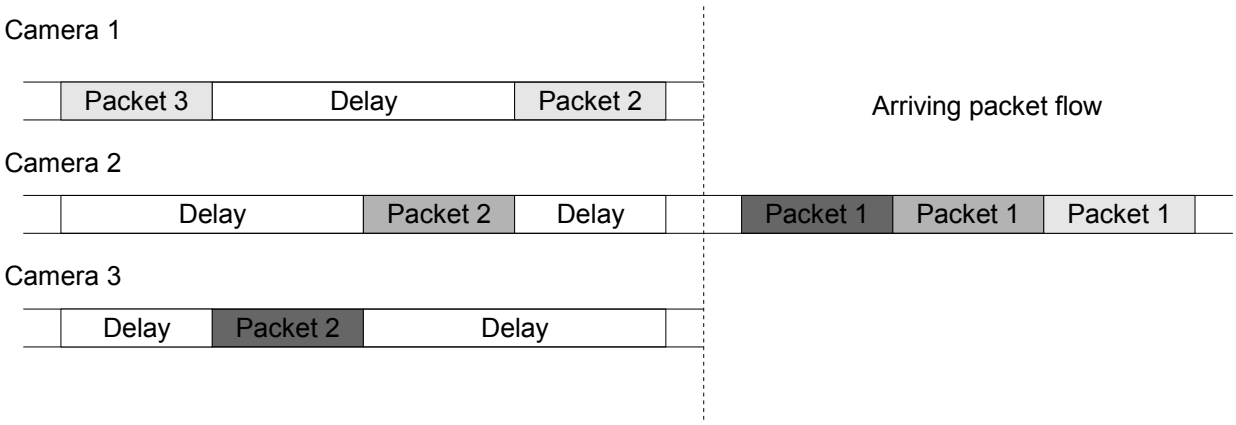


Figure 45: Example: inter packet delay (three cameras)

4.6. Area Of Interest (AOI)

Area Of Interest feature allows you to select a specific part of the image sensor area. In other words, only the pixels from the area defined by your settings will be transmitted to PC. The parameters that can be set:

- Vertical pixel offset
- Vertical pixel count
- Horizontal pixel offset
- Horizontal pixel count

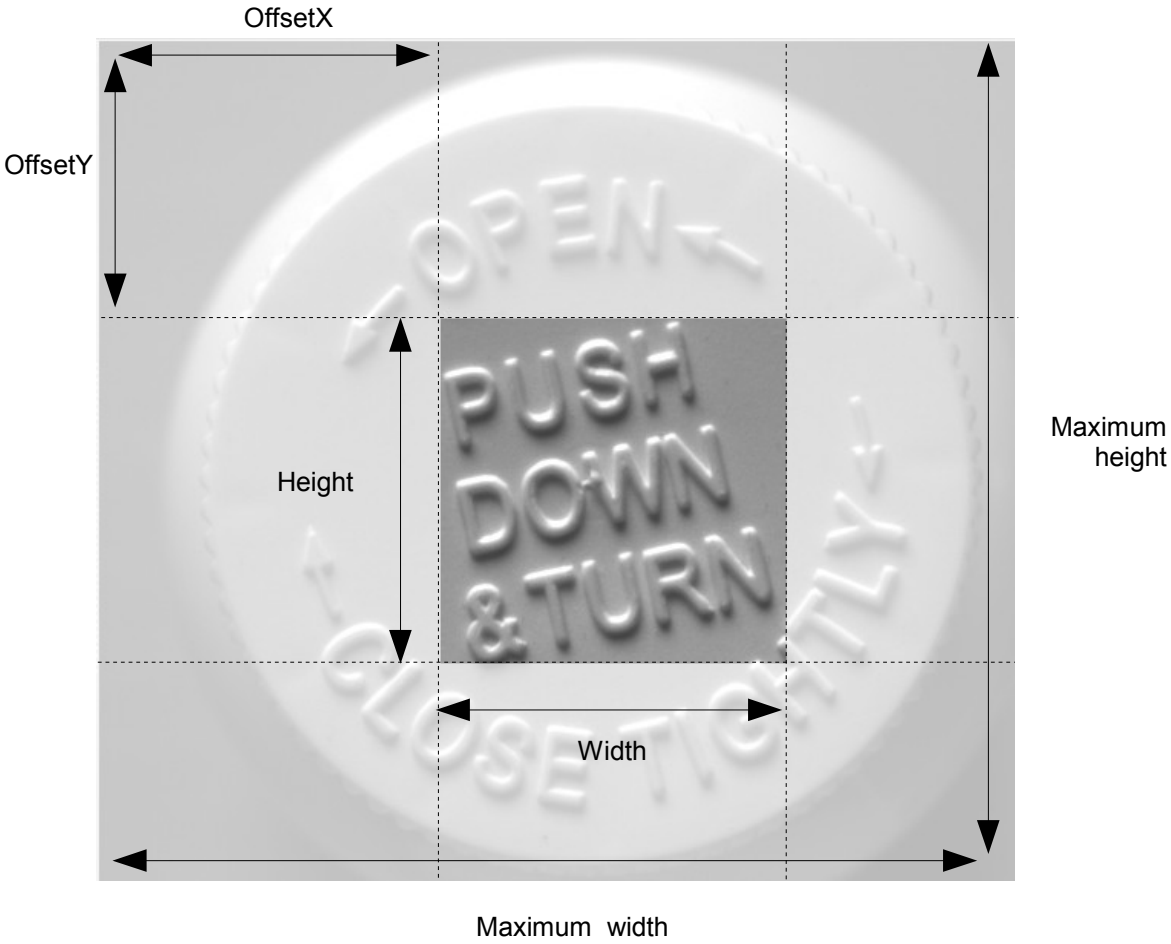
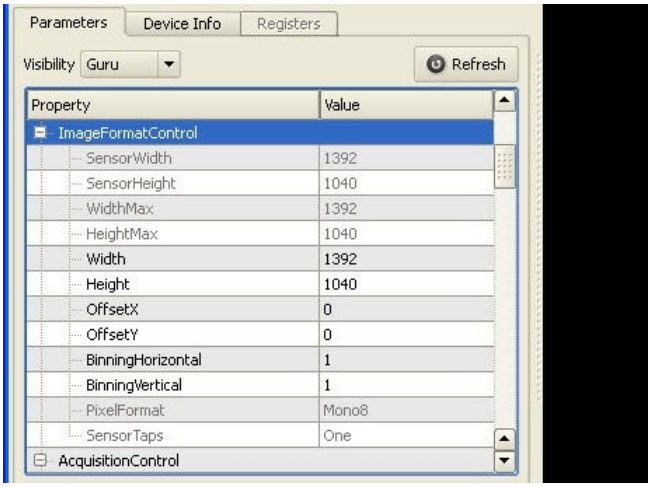


Figure 46: Area Of Interest

To increase frame rate at CCD cameras, vertical image size can be decreased. Decreasing horizontal image size does not increase frame rate at CCD cameras. For CMOS cameras decreasing vertical or horizontal image increases frame rate. It can be used to minimize data exchange.

4.6.1. Setting Area Of Interest

Area Of Interest is defined in the *ImageFormatControl* section.



Here is an example of setting the Area Of Interest.

Values for image below:	Values for image below:	Values for image below:
Width 1392,	Width 879,	Width 879,
Height 1040,	Height 535,	Height 535,
OffsetX 0,	OffsetX 0,	OffsetX 255,
OffsetY 0.	OffsetY 0.	OffsetY 380.

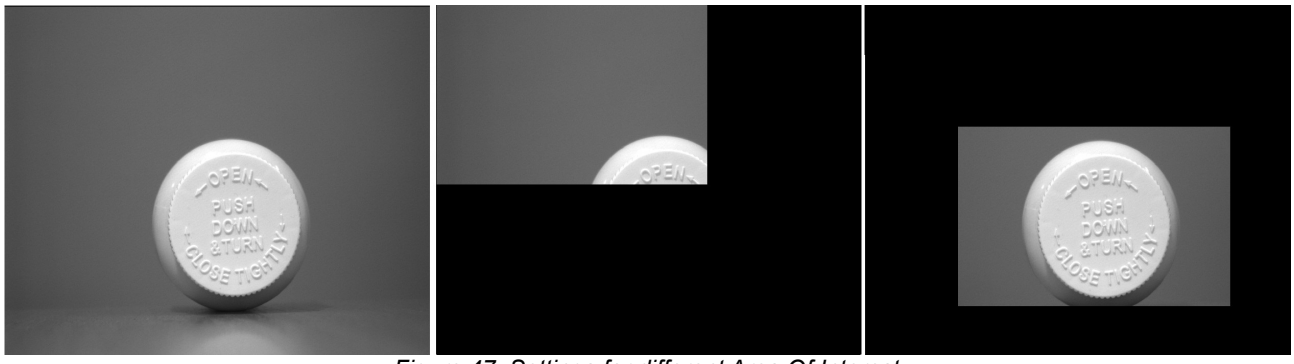
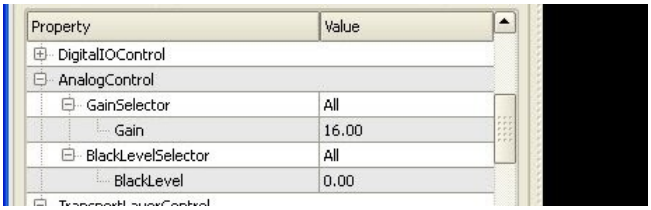


Figure 47: Settings for different Area Of Interest

4.7. Analog control



4.7.1. Gain

Gain property controls the selected gain as an absolute physical value. This is an amplification factor applied to the video signal. The unit and values of this feature are specific to the device and must be defined in the XML device description file. The camera's gain is expressed in decibels. CCD signal is amplified and digitized in analog-digital converter. By setting the gain we are adjusting camera's gray values. Gain also increases image sensor's analog noise. Default gain and gain range for each image sensor is defined in the section *3.4 Sensor information and technical specification (all models separate)*

4.7.2. Black level

BlackLevel property controls the analog black level as an absolute physical value. This represents a DC offset applied to the video signal. The unit and values of this feature are specific to the device and must be defined in the XML device description file. Black level is an additive to camera's analog video signal before digitization. Black level offset increases or decreases image brightness. It's expressed in percentage (full scale).

Here are examples of setting the *Gain*. In the left image *Gain* is set to 19, and in the right is set to 14.

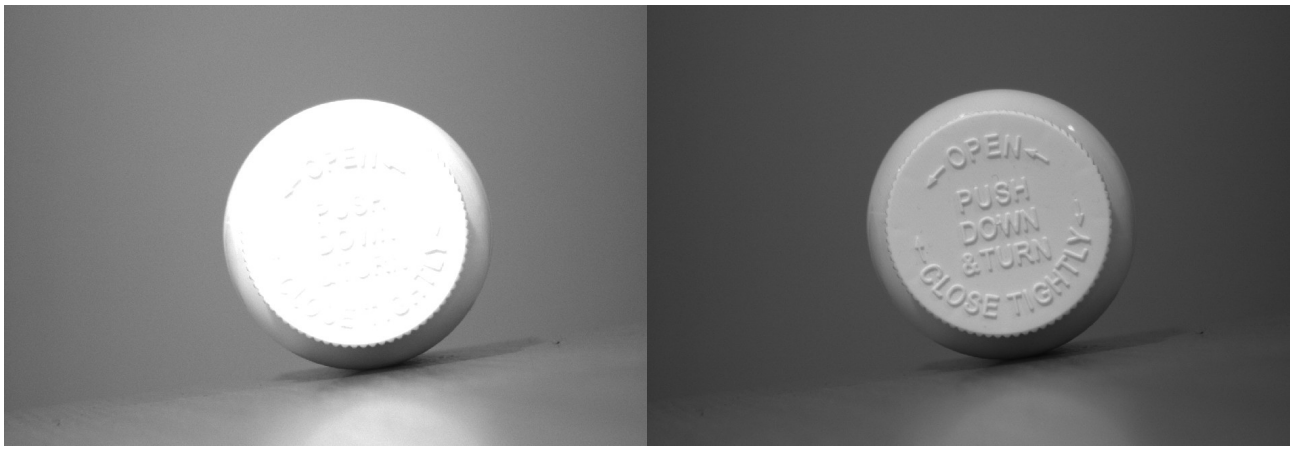


Figure 48: Different gain set

4.8. IR filter and IR-cut filter (optional)

Infrared filters are long-pass filters that block the visible light and pass IR light. They are characterized by their cut-on wavelength, typically the wavelength at which the transmission is 50% of the maximum. These filters use absorptive glass, that is robust, cost-effective and insensitive to angle of incidence.

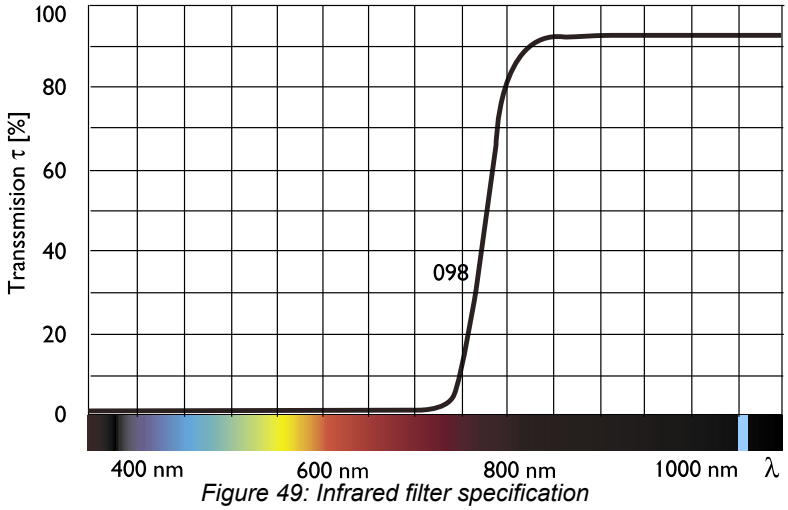


Figure 49: Infrared filter specification

The IR-cut filter is a short pass filter that blocks infrared light and transmits the visible, also based on an absorptive glass.

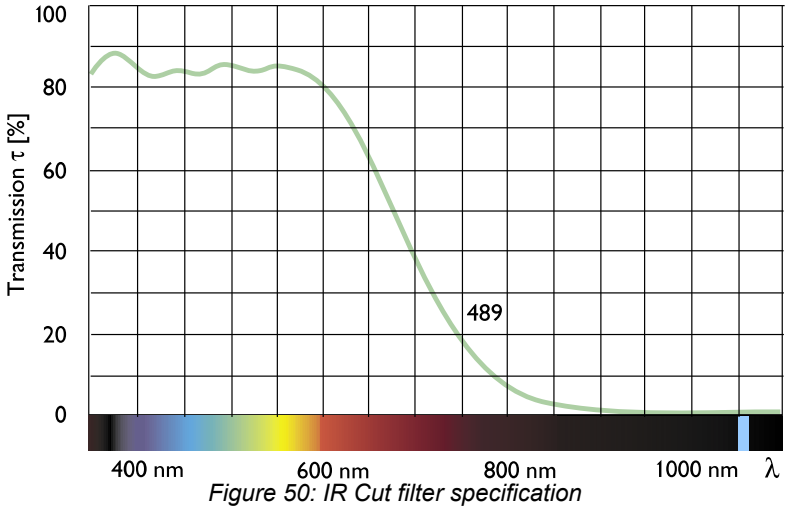


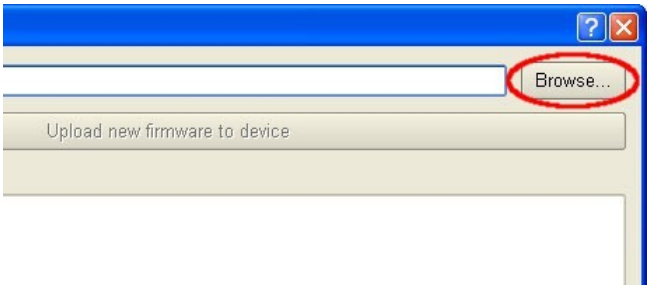
Figure 50: IR Cut filter specification

4.9. Firmware update

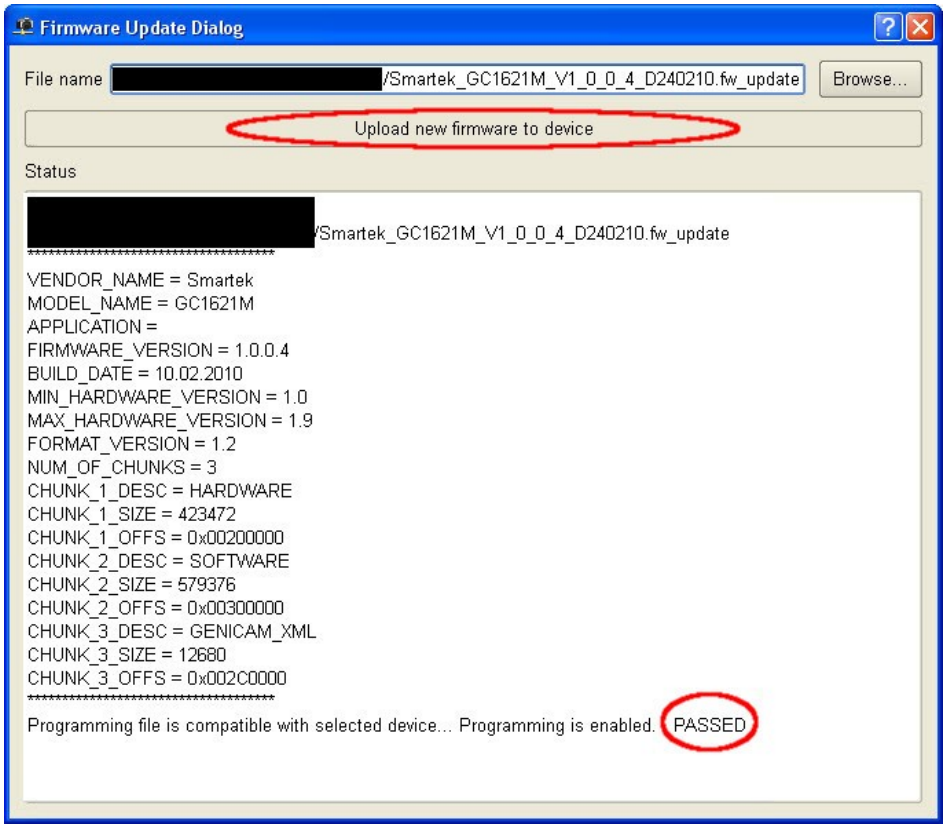
To update the camera firmware follow these steps:

Under ***Control*** menu press **Firmware Update** option.

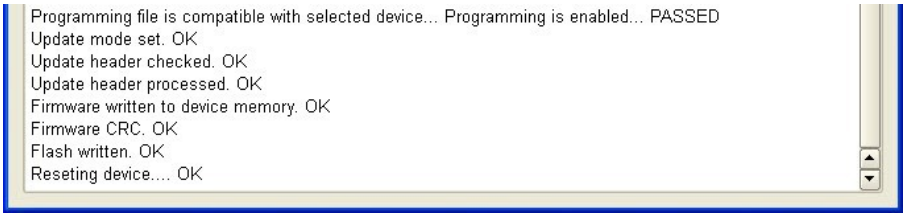
Click on the **Browse** button to select a firmware to install.



Find and open a firmware to install. After selecting and opening firmware, program will run a compatibility test between the device and firmware. If the selected firmware is compatible *"PASSED"* is indicated in text window. **Upload new firmware to device** button will become available, click on that button.



The device calculates Cyclic Redundancy Check (CRC) of uploaded firmware. If the CRC is OK, firmware is written to device's memory. This process can take a couple of minutes. When updating of new firmware finishes, simply close the dialog box. The below image shows successful firmware update.


Programming file is compatible with selected device... Programming is enabled... PASSED
Update mode set. OK
Update header checked. OK
Update header processed. OK
Firmware written to device memory. OK
Firmware CRC. OK
Flash written. OK
Reseting device.... OK

In case of any errors, please repeat the update process.

5. FAQ - Frequently asked questions

Q. What image sensors are used on Giganetix cameras?

A. Our Giganetix cameras use CMOS image sensors from Aptina and CCD image sensors from Sony and Kodak.

Q. What is the camera architecture?

A. Giganetix camera uses Altera Cyclone III FPGA.

Q. What is the maximum Ethernet cable length that can be used with Giganetix camera?

A. The maximum Ethernet cable length is 100m.

Q. How do you connect to Giganetix camera from PC?

A. Giganetix camera comes with GigE Vision compliant client application (to display images) and IP filter driver which filters GigE Vision stream channel data (images) from network traffic. This way CPU utilization is reduced to minimum so there is enough CPU power left for image processing.

Q. What is the maximum frame rate of Giganetix camera?

A. Maximum frame rate of camera is defined as maximum frame rate at full resolution and is different for every camera model (if image sensor area is bigger, maximum frame rate is smaller, for same pixel clock frequency). User can choose to increase frame rate by reducing image AOI (area of interest).

Q. What is “partial scan”?

A. Frame rate of camera (number of images camera captures per second) depends on AOI (image width x image height) and pixel frequency (if exposure time is small enough). When higher frame rate is needed, user can choose to reduce number of rows to scan by dropping lines from start or end of image (image is only partially scanned). This effectively reduces AOI and thus increases frame rate.

Q. What are the minimum and maximum exposure times for cameras?

A. The minimum and maximum exposure times for cameras are defined in accompanied documentation.

Q. How to connect more then one camera to PC?

A. To connect more cameras to PC use a Gigabit Ethernet switch or PC NIC with multiple ports.

Q. Why are there noise lines in the *GigEVisionClient?*

A. The noise lines represent the loss of data packets. Please check your NIC, Ethernet switch and network settings. Use *GevSCPD* property to increase inter packet delay.

6. CE Conformity declaration

We,

Smartek d.o.o.

Ziskovec 141, HR-40000 Cakovec, Croatia

Contact Person: Mr. Damir Dolar

Email: info@smartek.hr

Hereby declare that:

Product:	Digital Gigabit Ethernet Camera
Type Family:	Giganetix
Type:	GC1281M, GC2041C, GC2591M, GC2591C, GC3851M, GC3851C GC651M, GC651C, GC652M, GC652C, GC653M, GC653C, GC781M, GC781C, GC1031M, GC1031C, GC1291M, GC1291C GC1391M, GC1391C, GC1392M, GC1392C, GC1621M, GC1621C, GC2441M, GC2441C, GC1021M, GC1021C, GC1601M, GC1601C GC1921M, GC1921C

Is in compliance with the essential requirements and other relevant provisions of the following EC directives.

Reference No.	Title
89/336/EEC, 92/31/EEC	Electromagnetic Compatibility (EMC directive)

Following standards or normative documents:

EN 55022:1994 Class A + A1:1995 + A2:1997,

EN 61326:1997 Class A + A1:1998 + A2:2001 + A3:2003,

EN 55024:1998 + A1:2001 + A2:2003

The product specified above was tested conforming to the applicable Rules under the most accurate measurement standards possible, and that all the necessary steps have been taken and are in force to assure that production units of the same product will continue comply with the requirements.

Damir Dolar

13. Jun. 2011

Damir Dolar
Dipl. Ing. Hardware Engineer
Smartek d.o.o.

7. Smartek Information

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